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[Special Editorial Correspondence.—By Telegraph.]

THE NINTH ANNUAL MEETING OF THE PACIFIC COAST GAS ASSOCIATION.

OFFICE SAN FRANCISCO GAS AND ELECTRIC COMPANY,
415 POST STREET, SAN FRANCISCO, CAL.,
July 18th, 1901.

Dear JOURNAL: The technical sessions of the ninth annual meeting of the Pacific Coast Gas Association were completed yesterday afternoon, to the pleasure of the visitors, the profit of the members and to the strengthening of the Association. The banquet last night, which was served in Delmonico's, on O'Farrell street, was in the nature of a successful consummation and a significant prelude. A consummation, in that the professional end of the convention had been happily concluded; a prelude, in that after the banquet, for the morrow, the charming roads and waves of "Lagunitas" were to be tried. With the inspiring accompaniments of excellent headquarters, the finest of California weather and a large attendance, the blond gentleman from Oakland, Mr. John A. Britton, who directs the fortunes of the Oakland Gas Light and Heat Company, called the meeting to order at the appointed time. Just a little perturbed the conqueror of Councils was when the ripple of applause that greeted the call to order reached his ears, but his perturbation did not even momentarily prevent him from calling on his slim, natty aide, Secretary J. B. Grimwood, for the regular order, which was at once forthcoming. Very little time was wasted in getting on with the regular proceedings. To sum the whole matters up briefly, perhaps I had better recount them this way: The attendance in respect of members present was 69, and there was a goodly representation of guests, prominent amongst whom was Mr. William McDonald, of Albany, N. Y.—ex-President of the Western Gas Association, delegate to the International Gas Congress, etc.—to show that he knew what a good thing was, his name subsequently appeared in the list of newly elected members to the Coast Association. The total accession to the membership rolls, by the way, counted 13. The reports of the Secretary and Treasurer, and the reports from the routine committees as well, showed that the Association was prospering in every sense. President Britton's address was a scholarly and interesting document. In it he commented on the benefits to the gas industry at large which had accrued from the deliberations of the International Gas Congress last fall, made mention of the growth in importance of the plan for gas distribution under high pressure, and dilated on the advantageous outcome of placing in use large unit gas engines. He recommended the forming of an advisory board for the benefit of the small gas companies on the Coast, advocated the establishment of an information bureau, to be under the management of the Association's Directors, with headquarters in San Francisco. He called attention to over-capitalization as an invitation to the taking on of municipal ownership by local authorities, commended the useful influence exerted by the rulings and doings of the Massachusetts Board of Gas and Electric Light Commissioners, and hoped that California would see its way clear in time to try a similar practice. He advocated the creation of a course entitling the graduates to the degree of Gas Engineer from the colleges of the Coast at least, if not from all American colleges. It was also recommended that the title of Honorary Membership be conferred upon M. Theo. Vautier, of France, who so ably presided over the International Gas Congress, and upon

LIBRARY OF CONGRESS
JUL 22 1901

Professor T. S. C. Lowe. How far all these suggestions were concurred in by the Association will be shown later on in the official report; but I'm quite sure I am not far astray when I say that the men, in respect of them all, thought with the master. Another thing that might be here noted was the determination of the Association to form a library, many generous donations to the maintenance of which were put on the record. President Britton's address was an excellent one. All the papers listed (save that on "Gas Engines," to have been handed in by Mr. William Casey) were read as per programme; and a right good lot they were. They all brought out good discussions. Perhaps Secretary Grimwood's recital of his inspection of and experiences in the International Gas Congress, in Paris last year, on which occasion he represented the Pacific Coast Gas Association, was the feature of the list. The paper by R. P. Valentine, of Sacramento, Cal., on the "Promotion of Fuel Gas Consumption," was also exceptionally well received. The "Wrinkle" and "Experience" departments, and the Question Box added notable quotas to the fund on account of the technical side of the meeting. In fact, the technical and social sides of the convention were fully all that they should have been. The next place of meeting will be San Francisco. The officers elected for the ensuing year are:

President—Mr. C. E. Burrows, Walla Walla, Wash.
Vice-President—Mr. M. E. Osborne, Chico, Cal.
Secy. and Treas.—Mr. J. B. Grimwood, San Francisco.
Editor, "Wrinkles"—Mr. George S. Colquhoun, Fresno, Cal.
Editor, "Experiences"—Mr. O. M. Gregory, San Jose, Cal.
Directors—Messrs. John Martin, F. J. Symmes, W. A. Aldrich, and Geo. S. Colquhoun.

The banquet at Delmonico's last night was a perfect success. The viands were excellent, the toastmaster (Mr. Jno. A. Britton, was irreproachable, the good fellowship was irresistible and the attendance was a record in the Association's history. The speeches were as sparkling as the "water" that moistened the throats of the speakers, and I would not have said it all did I not note that the East and West fairly divided the honors between them in the matter of responses to the toastmaster's urging—McDonald for you, Crockett for us. For a moment or two (yes, for a full minute or two) the toastmaster completely lost the power of tongue, which condition was brought about, when Mr. R. M. Powers, President of the San Diego (Cal.) Gas and Electric Light Company, in a beautifully worded speech presented to Mr. Britton a handsomely wrought and suitably inscribed loving cup. The presentation, as Mr. Powers gracefully put it, was made on behalf of the San Diego Company in recognition of Mr. Britton's assistance rendered when the Company was in trouble, and as a further tribute to his aid to every gas man on the Coast. When the toastmaster recovered himself partly, he made a fraternal reply, but it was not in his usual vigorous style. A feature of the banquet came out in the shape of a series of hand painted menu cards, each of which made out a strong case against some member of the Association. I may be able to send you some account of the outing to-morrow, but whether I do or not you may write it down that the Coasts' Ninth Meeting was a record one.—B.

Miscellaneous Notes of Interest to Electric Central Station Men.

By Mr. W. H. Wakeman.

One objection to springing an arch over the top of a tubular boiler is that it tends to spread the side walls and there are enough forces at work to disturb these walls without the arch. Another objection to it is that where it is close to the boiler when new, a slight settling of the arch may bring the whole weight of it on the boiler where it is not wanted.

Still another objection is that if a leak appears in any of the seams in the steam space it is difficult to get at it for the purpose of making repairs. These objections may have weight, or not, according to conditions, but I believe it possible to secure all of the benefits of a brick arch by using some material that is fully as good in every way, and still has the advantage of being much lighter. Asbestos in some of its various forms will answer every purpose.

The power pump is an economical boiler feeder when used in connection with a good exhaust steam heater, because the power used to operate it is developed by the engine, and this is supposed to be of some approved kind which uses steam to a good advantage.

The direct acting steam pump is wasteful of steam, but its speed can be so nicely regulated to suit various requirements, that it is justly popular with engineers and steam users. Where a power pump is supplied with a device for regulating the amount of water delivered, it becomes a very desirable machine. A set of cone pulleys by which the speed of its countershaft may be changed at will, or a circulating pipe that lets some of the water in the delivery pipe run back into the suction, will accomplish this result.

Thousands of dollars are now invested in separators where they were unknown a few years ago, and as a rule, to which there are very few exceptions, the investment is found to be profitable. With a good separator on the exhaust pipe of an engine, and a mineral oil used in the cylinder, it is practical to remove the oil, leaving the steam pure to use for other purposes, and making it safe and economical to return the water of condensation to the boilers. Some complaints are still made about the failure to take out all of the oil or grease, as it is commonly called, but where such is the case there is some cause for it, the same as there is for everything else. If a kind of cylinder oil has been used that comes out of the exhaust steam readily it is a very good plan to keep right on using that oil, and not experiment with some other kind that is of doubtful quality and of uncertain origin.

We are told that if the height of a brick chimney is accurately measured when cooled down to the temperature of the atmosphere, and again measured when heated by the passage of hot gases through it, the difference will be about 1 inch for each 25 feet in height. This does not apply to the outside of such a chimney where the heat does not affect it, but to the brick work that is actually heated to a high temperature.

This demonstrates that a chimney should stand by itself, and not be built rigidly into the walls of a building. It also shows that the outer and inner walls should be given a chance to expand and contract separately.

Some of our heavy duty steam engines with their massive frames are very stiff and unyielding, which of course is a very desirable feature where heavy and continuous work is to be done, but their very stiffness prevents that smooth and almost noiseless operation that characterizes others that spring and give to a slight extent. It is claimed that some engines will not run quietly when set on a perfectly rigid foundation, but we prefer the best one that can be laid, for in this case as in many others the best is none too good.

When the amount of cylinder oil that an engine requires per day is determined it is useless to feed more than is needed, as it is simply just so much wasted. Very few oil pumps operated by hand are now used for this purpose, because it requires too much time to attend to it, and a large quantity of oil put in once an hour does not answer the purpose as well as one or two drops per minute. A separator may work well on the exhaust pipe of an engine where a sight feed lubricator is used, that will not take out all of the oil delivered in large doses by a pump.

It is a good idea to have an injector piped so that it can take water from a tank with a lift of from 2 to 6 feet as the case may be. Many injectors that are found satisfactory when used in this way do not give good results when the water comes to them under pressure. If the pressure was always the same they would work better, but in ordinary cases others draw from the same pipe that feeds the injector, and when the engineer or fireman adjusts the water valve so that the supply is right for the steam pressure, there is no trouble, but when somebody opens a faucet and takes nearly all the water away from the boiler feeder, it "kicks," and in a few minutes the water pipe is filled with steam and hot water, which prevents it from working until the whole thing is cooled off.

On the other hand, if it is piped so that it can only draw water from a tank on a lower level, something may cause it to "kick" in that case, and it must then be cooled off before it will work again. If this has to be done by pouring water over the injector and pipes, it does not improve the appearance of the room, therefore it is well to connect a pipe so that water can be forced through the suction pipe and injector, for then the whole can be cooled without spilling water on the floor.

How little some engineers seem to care about keeping their machinery in good order. The corners of nuts are rounded off by using wrenches that spring, cold chisels are used on every convenient occasion, and Stilson wrenches are employed to loosen nuts and pipes where some other tool that would not leave "trade marks" behind it might just as well have been brought into service.

One of the worst cases of this kind that we have ever seen was where pipe tongs had been put on a piston rod that was about 3 inches in diameter in order to unscrew it from the cross head. Sufficient pressure had not been applied to the handles to make it hold at first, so that it had scraped along the surface of the rod until it finally "took hold," and brought the rod out.

If that engineer studied the wooden pulleys on the shafts of that mill he might have discovered that a block of wood when split in two and sawed out to fit a shaft or a piston rod, and bolted in place, will afford a good place for a large wrench to be used. When it is taken off it leaves no marks behind it.

High and Low Pressure Gas Incandescent Lighting.

[A paper read by Mr. William Sugg, of London, at the 37th Annual General Meeting of the Incorporated Gas Institute.]

The Lord Mayor of London, in his speech at the Common Council in the early part of this year, complained of the "unsatisfactory manner in which the streets of the city are lighted." Money has been spent in the most liberal manner in putting up immensely tall lamp posts of various artistic designs, surmounted by a cast iron arrangement resembling old sign posts seen outside the inns in some parts of the country. From this, instead of the sign, hangs an electric globe arc lamp, which generally, when it is lighted, has a smudgy looking shadow at the top and bottom of the globe. For one-tenth of the money which has been expended over this unsatisfactory lighting, it is safe to say that a magnificent and much more practical result could have been obtained if gas had been used.

Mr. Corbet Woodall, in his Presidential address to the Southern Association of Gas Engineers and Managers, delivered on March 14 last, said: "I know many cities, in many lands; and I am constrained to declare that London, which saw the first gas company started nearly 100 years ago, is at this hour the worst lit capital city in Europe. To return to London from Vienna, Berlin, Paris or Brussels, is to pass from light and cheerfulness to dismal darkness and gloom. Yet gas is far cheaper in London than it is in any other capital, and its quality is higher. This condition of things as regards the public lighting of London is a scandal, a reproach and a danger. It is not that those who should take pride in having the best of everything for our wonderful metropolis can plead ignorance of the possibilities of gas lighting. Here and there—in spots—the gas lighting is splendid, the very best in all the world."

Mr. Woodall referred to the lighting of a part of the Strand by means of the new high pressure incandescent gas lamps of 1,000-candle power each, which are fixed at the crossway formed by Wellington street, Waterloo bridge and the Strand. Although there are several electric lights in close proximity to the 1,000-candle gas lamps at Wellington street, they, as *Mr. Punch* says, "blink in dismay." There are six of these powerful lamps at this point, each furnished with a cluster of three high pressure incandescent burners consuming an aggregate quantity of 30 cubic feet of gas per hour. Each burner is provided with a special Welsbach mantle made for use with high pressure gas, and of the model originally designed by the writer, and made and supplied to him by the Sunlight Incandescent Mantle Company previous to their amalgamation with the Welsbach Company.

A large number of experiments made by the writer proved that the mantles manufactured after this model gave a much better result in illuminating power, and lasted longer, than the No. 4 Welsbach mantles which he first used with high pressure burners. The duration of these mantles has been found to average in all the installations which he has carried out in various parts of the kingdom, 1 to 2 months, and sometimes even as much as 4 months. Their shorter average life is, of course, due very much to the number of mantles which break up at once on being lighted, because of some broken threads or other defects in the manufacture, and also sometimes by carelessness on the part of the lamplighter. But with properly made mantles, burning in suitably ventilated lanterns, and with ordinary care, they ought to last on the average from 6 weeks to 2 months. The stronger mantles now made are much superior in light giving power and durability to those which were supplied at the inception of his system of lighting.

In localities where there is such a great vibration as there is in the Strand and Whitehall, each burner should be furnished with an anti-vibrator, in order to preserve the mantle from the conttnual slight shocks caused by passing vehicles; and this has been provided against by means of special springs. The importance of using a lasting mantle, notwithstanding its greater cost, is obvious.

I dare to say that the electric arc light is not suitable for street lighting for many reasons—the principal ones being its want of volume, and the apparent solidity of its shadows. It is a significant fact that on the Continent, in Germany and France, incandescent gas lighting is taking the place of electricity, because it is much steadier and has greater volume.

In a paper read before the Gas Institute, many years ago, the writer pointed out the difference between the volume and intensity of light, by the effect produced in lighting a coal wharf by means of the old-fashioned brazier filled with burning coal. This threw a great volume of light of a reddish color all round with practically no shadow; while the rays of an arc lamp of the same power were so intense, and the shadows appeared so solid, that the men mistook them for planks and accidents happened in consequence. The reason of this is that the arc electric light has so much blue and violet rays in it as to affect most injuriously the eyesight, and at the same time reduce the volume of useful rays. In fact, the light from the coal brazier, consisting principally of the red and yellow rays, is diffusive, somewhat like the light of the sun, while the rays of the electric light, of high refrangibility, emanate from a very small point no bigger than the tip of the finger, and, therefore, the shadows are hard and black. For example: The area of illumination of a brazier, when thoroughly incandescent and giving a light of about 1,000 candles, is from 150 to 160 square inches, while that of an electric arc light of the same candle power is not more than $\frac{1}{8}$ square inch. Hence the troublesome shadows.

The question of the rapid advance of gas in lighting streets, large spaces, railway stations, docks, etc., depends much on the possibility of being able to get good mantles as well as good burners. On this latter point it is to be noted that, exactly as with the old standard London Argand burners, in order to obtain the highest duty per cubic foot of gas consumed, the pressure at the point of ignition must be very low; and as Sir Frederick Bramwell said, in speaking in court in the celebrated Silber trial, "the flame must be kept hot."

The velocity of the issuing gas, when lighted, through the 24 holes of the London standard Argand burner is 5.25 feet per second, when it is consuming 5 cubic feet of gas per hour; and the pressure at the point of ignition is about $\frac{1}{100}$ of an inch. The duty obtained with 16-candle gas for this consumption is 3.2 candles per cubic foot. The number of holes in the inner ring of the writer's low pressure 110-candle incandescent burner, which consumes also 5 cubic feet of gas, is 12, and that of the outer ring is 24. The aggregate area of the 36 holes is 113 square m.m. The quantity of gas which passes through the jet at the base of the burner - viz., 5 cubic feet per hour—issues at a velocity of nearly 111 linear feet per second.

The air for the combustion of this quantity of gas inside the mantle induced by the velocity of the jet of gas, is about 5 feet of air to 1 foot of gas. Assuming these proportions to be correct, then the velocity of the gas at the point of ignition would be about 30 per cent. greater than it is in the London Argand burner. The illuminating power of 5 feet of gas thus consumed by the low pressure incandescent burners is from 110 to 120 candles, according to the quality of the mantle, or from 22 to 24 candles per foot, as compared with a total of only 16 candles produced by the London standard Argand burner for the same quantity of gas, or 3.2 candles per cubic foot.

With the writer's high pressure burner used at Wellington street and other places in clusters of three, forming the 1,000-candle lamps, the volume of gas issuing from the jet is about 10 cubic feet per hour; and its velocity is about 260 linear feet per second. The volume of air passing up the tube of the burner induced by this 10 feet jet of gas is estimated to be 70 cubic feet per hour to 10 cubic feet of gas; and the velocity of the issue of the mixed gas and air at the point of ignition would be about 12.5 linear feet per second, or nearly double that of the low pressure incandescent burner. The result obtained for this consumption is 320 candles, with a good mantle—32 candles per foot.

It is remarkable the standard London Argand gives 3.2 candles only per cubic foot of gas consumed, or one-tenth the amount of light which the gas can yield, when burnt in a high pressure burner. The quantity of air supplied into the interior of the mantle with the gas is not sufficient to produce perfect combustion; but the mixed gas and air burning under the mantle exercises a very powerful attraction on the oxygen of the surrounding atmosphere, and causes it to part company with the nitrogen, with which it is only mechanically combined, and diffusing itself through the meshes of the mantle, meets the heated mixed gas, and combining with it on the surface of the mantle produces a very brilliant white light, very similar to the oxy-hydrogen lime light. This duty of 32 candles to the foot does not seem to be increased per cubic foot by an increase in the velocity of the volume of gas issuing from the point of ignition of the burner; but the illuminating power of the burner can be increased up to about 400 candles, with an increase of 2.5 cubic feet of gas, or a total consumption of 12.5 feet instead of 10 feet. This extra $2\frac{1}{2}$ feet of gas gives to the burner a considerable increase of light, and the extra $2\frac{1}{2}$ feet represent a duty of 40 candles to the foot including the 32 candles mentioned. This quantity of gas—viz., 12.5 cubic feet per hour—issues at a velocity of about 300 linear feet per second from the jet at the base of the burner, and 18 feet per second from the point of ignition.

The writer's London Argand burner, K size, consuming 10 feet per hour, has a ring drilled with 42 holes and a central jet. The pressure at the point of ignition is rather less than that of the London standard Argand. The velocity of the issuing gas at the point of ignition is 3.8 linear feet per second, instead of 5 feet per second as with the London standard Argand. The illuminating power obtained for this consump-

tion is 45 candles, or 4.5 candles to the foot. The velocity at the point of ignition in the Argand, and in the incandescent burners, is as follows:

Standard London Argand	5.25 ft. per sec.
New 5 feet low pressure incandescent.....	6.80 "
K Argand, burning 10 feet per hour	3.80 "
10 feet high pressure incandescent	12.60 "
12–15 feet high pressure incandescent.....	18.00 "

It is apparent from these figures that with incandescent burners the velocity with which the gas issues from the jet at the base of the burner is a very important factor in obtaining these high results. It is also clear that a much increased velocity of the gas issuing from the top of the burner is of no less importance, but this velocity must be without appreciable pressure.

Referring back to what was known about incandescent and other burners at the time of the Electric and Gas Exhibition, 1882-83, as to the conditions under which an improvement in the illuminating power of the gas was to be obtained, it is noticeable that these two important conditions did not appear to have been known to the inventors of the early incandescent burners which were then shown there by Lewis, Clamond and Popp. They, with their gas and air under high pressure —from 6 inches, and even as high as 14 inches—did not obtain more than about 4.26 candles to the foot, which was less than that obtained by Siemen's 266-candle recuperative lamp, with a consumption of 55.75 feet, or 4.77 candles to the foot, and the author's 451-candle Argand, with a consumption of 94.80 feet per hour, or 4.77 candles to the foot. The writer's flat flame Lambeth lamp, with 28.30 feet per hour consumption, also gave 98 candles, or 3.76 candles to the foot: so that at that time, notwithstanding all that had been done, there was comparatively very little improvement on the London Argand standard burner.

Both the Lewis and the Popp burners were fitted with mantles made of fine gauze platinum; and it is rather curious that in this respect the originator of that idea was the late celebrated French chemist, St. Claire Deville. The writer, in the year 1865, was told by this distinguished ***savant,*** in a lecture he was giving to students, that "we did not burn gas properly so as to get the best result from it." He said: "You use a Bengel burner (Argand) like this [and he lighted up the burner]. Now you do not get anything like the volume of light you ought to be able to get from this quantity of gas (about 5 feet). But if you take off the chimney and put this little ***manchon*** on the combustion chamber, you will see a very different result." The little ***manchon*** was a mantle made of very fine platinum gauze. He then replaced the chimney and lighted the burner. The result was indeed very different, and greatly astonished us. He, however, turned it out very quickly, saying that "he could not keep it alight any longer for fear of destroying the ***manchon;*** but," said he, "this is the way in which you must march." This was, I believe, the first idea given to the world of the method of incandescent lighting by gas, and what it could accomplish.

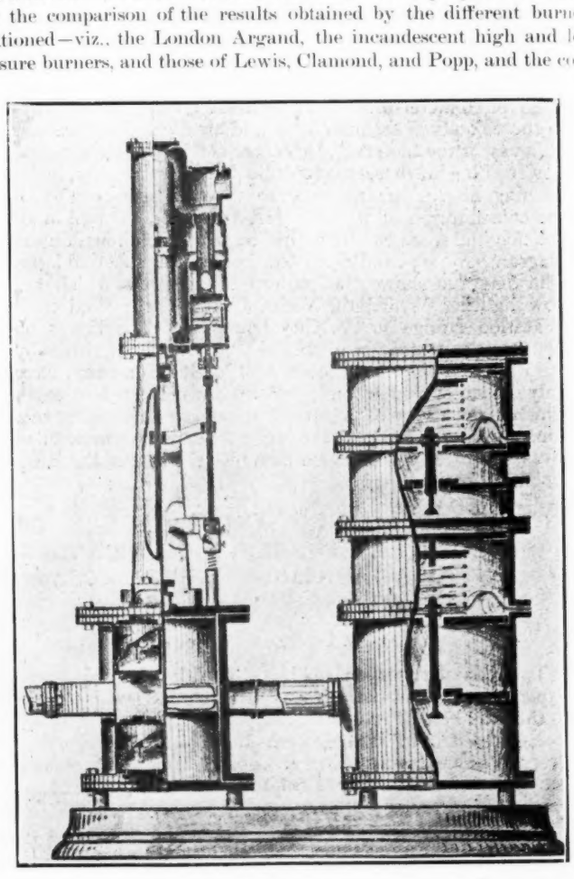
Just before the Electric and Gas Exhibition at the Crystal Palace above mentioned, M. Clamond, of Paris, produced a burner fitted with a ***manchon*** made of oxide of magnesia, which looked very much like a long strawberry basket. As I have said, with a consumption of 7½ cubic feet of gas per hour, he only obtained a light equal to 32.7 candles. With the new burners of to-day, we should get easily more than 150 candles for that consumption. He used a long chimney.

There was no further advance made in obtaining a higher illuminating power per cubic foot of gas than this until the Health Exhibition in London, when a Wenham lamp (an improvement on Grimstone's inverted burner shown at the Crystal Palace Electric and Gas Exhibition) and a "Cromarty" lamp by the son of the writer, gave an illuminating power of about 8 candles to the foot. Both these burners, with subsequent improvements, reach at the present day to the figure of 12 candles to the foot, with a consumption of 15 or 20 feet per hour.

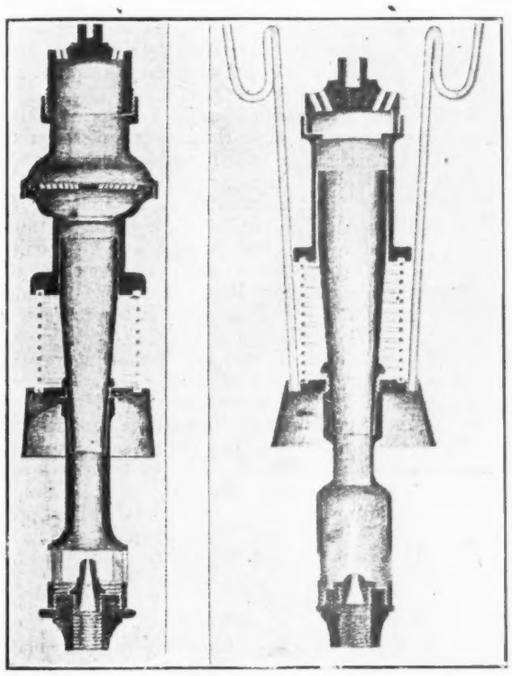
The very high result which can be obtained from gas at the present moment is principally due to the discoveries of Baron von Welsbach, who appears to have been the first to find that the platinum gauzes were useless for the manufacture of mantles for incandescent gas, and that what was required was a mantle made of materials which were able to support, without melting away, the intense heat produced by the combination of the oxygen and the mixed gases on its surface. The peculiar property of platinum of becoming incandescent when exposed to a current of gas, misled all who, like the writer, had been making experiments from time to time with it during all the years which elapsed from the time St. Claire Deville showed his mantle and the discovery of Welsbach.

This paper has been prepared with the object of placing before the members, as briefly as possible, some of the principal points in the improvements which have been made in the illuminating power of ordinary gas during the last 30 years. It may seem to some that the progress has been slow, and that the improvements have been rather spasmodic than otherwise. The remark of the great ***savant*** St. Claire Deville, that we should march in the way of incandescence if we desired to effect improvements in producing light by the use of gas, slumbered for many years before the first Welsbach mantle was exhibited in Vienna. From that time, it has steadily progressed until we have arrived at a new era in gas lighting. The new century will certainly see gas taking an important position in public and private lighting, owing to the marvellous developments which have taken place in the facilities for its application, and to its steadiness and cheapness. Already, proprietors of railways, docks, and large workshops have adopted it: some of them abandoning the electric arc lamps, which are uncertain in their action, and sometimes suddenly go out or drop to a very low light. Where machinery is in motion, this is extremely inconvenient, and even dangerous. The writer does not anticipate that there will be any further reduction of the quantity of gas consumed to an almost vanishing point concurrently with an increase in the illuminating power per cubic foot, as some seem to expect, but rather believes that an enormously increased light will be produced, with present consumptions of 4 and 5 cubic feet per hour in the smaller lamps and private lights, and a much greater increase in larger consumptions of 30 and 50 feet for important street lighting, railway and dock lighting, etc. He considers that the general public and local authorities desire to get a much whiter light, more approaching to daylight, of very much greater volume, which will not injure sight, and that they do not so much wish for a reduction in the quantity of gas they have been accustomed to burn to produce the insufficient light which they now generally obtain with the use of the old fashioned burners. From about 1 candle per cubic foot of gas consumed with the old fishtails and batswings, to 32 candles per cubic foot now obtainable by incandescent burners and mantles, is nothing less than a marvellous progress.

In conclusion, it should be observed that, for the purpose of facilitating the comparison of the results obtained by the different burners mentioned—viz., the London Argand, the incandescent high and low pressure burners, and those of Lewis, Clamond, and Popp, and the combination flat flame burners—all are given as they appeared when tried on a long bar photometer; the volume of light yielded by horizontal rays only having been measured. The Wenham and the "Cromarty" were measured at an angle of 45°. But the full duty to be obtained by



Sugg's High Pressure Apparatus.



Sugg's High Pressure Burner. Sugg's Low Pressure Burner.

the use of the incandescent high and low pressure burners would be, in such a lamp as is shown on the diagram, fully 30 per cent. more than that obtained in the photometer room on the bar photometer, because, first, of the large reflecting top of the lantern and the increase in illuminating power due to the supply of air to the burner being warmed, instead of being cold, as it was when the burner was used in the open photometer room. There must be also an increase in the velocity of the mixed gas and air created by the long chimney of the lantern. In consequence, the illuminating power of one of these 1,000-candle lamps is actually, when burning in the streets, equal to 1,200 to 1,250 candles for the consumption of 30 cubic feet per hour, as used in all the nominal 1,000-candle lamps, such as are shown on the diagram or 41.3 candles to the cubic foot effective light. The diagram shows the pattern of the lamps which are now lighting Whitehall, Victoria and the Strand, from Waterloo Bridge to the city boundary. The lamps on Southwark Bridges of a special construction, lighted by the writer for the South Metropolitan Gas Company, have only one 10 cubic feet high pressure burner fixed in each, which gives a very high duty of about 400 candles for this consumption, because of the large reflecting surface, filled in with silvered glass, which occupies the half of the lamp which faces the river.

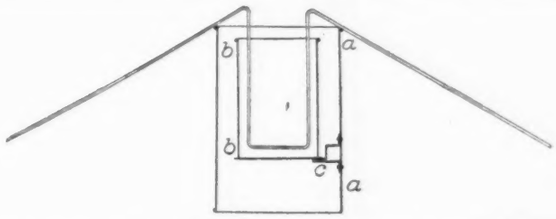
On the Determination of Hydrogen in Gas Mixtures.

By Mr. Francis C. Phillips, in *Jour. Am. Chem. Soc.*

The strongly exothermic character of the reaction involved in the combustion of hydrogen renders it possible to determine this gas by oxidation over palladium asbestos without the application of external heat. As the moisture produced in the reaction is liable to condense and cause the palladium to become wet, it is usual to apply heat in order to prevent this condensation and to insure the completeness of the reaction. For this purpose Winkler[1] recommends the use of a gas flame placed directly below the palladium asbestos tube. In heating over a flame the obvious danger occurs of burning hydrocarbons along with the hydrogen. The use of hot water as a source of heat presents the advantage that the temperature of the palladium is prevented from rising much above 100° C., provided that the rate of passage of the gas through the palladium asbestos tube is slow. Still it is somewhat difficult by any existing device to preserve a constant and definite temperature. The form of apparatus described below has proved convenient for maintaining the palladium asbestos at the temperature of boiling water for a period of time sufficient for the performance of a series of hydrogen determinations.

In the drawing, which represents the apparatus in section, *a a* is a brass cylinder 30 cm. long and 18 cm. wide. It is open at both ends, the rims being strengthened by wires. *b b* is a cup shaped vessel 18 cc.

1. Winkler and Lunge: "Handbuch of Technical Gas Analysis," 1885, p. 79.



deep and 12 cc. wide. When in use this inner vessel rests upon three supports which are riveted to the inner surface of the cylinder *a a*. One of these supports is shown at *c*. The space between the cup and the cylinder is nearly 3 cm. wide. The cup is silvered on the outside and the cylinder is silvered on both sides. Any of the mixtures which are sold for giving a silver coating to brass will serve for the purpose.[1] The palladium asbestos is introduced into the middle of a glass tube 70 cm. long and about 3 mm. in internal diameter. The tube is then bent into the form shown in the sketch and the U-shaped part placed in the brass cup, which is then filled with water. A small flame is kept burning under the cup and the water maintained at a temperature approaching the boiling point. The glass tube containing the palladium asbestos is connected at one end with a gas burette and at the other end with a Hempel pipette. The gas in which the hydrogen is to be determined, together with the necessary volume of air having been introduced into the burette, and the water levels being carefully adjusted, the gas is caused to flow slowly through the palladium asbestos tube into the pipette, and back again to the burette, the volume of the hydrogen being ascertained in the usual manner. The polished silver surfaces prevent radiation to such an extent that the accuracy of the gas measurements is not affected by the close proximity of the measuring apparatus to the source of heat.

The palladium asbestos is prepared by moistening long fibered asbestos with palladium chloride solution and igniting over a Bunsen burner flame, the process being repeated until the asbestos receives a sufficient quantity of the reduced metal (about 6 per cent. of the weight of the original asbestos has been found to be a convenient proportion). The deposition of the palladium occurs mainly on the surface of the bundle of asbestos fibers. It is well, therefore, in order to distribute the reduced metal as evenly as possible throughout the mass of the asbestos, to roll the fibers under a glass rod on a glass plate once or twice during the process of alternately impregnating with palladium chloride and igniting. Minute crusts of palladium accumulated upon the surface of the asbestos are liable to glow intensely, even when the tube is immersed in water, during the passage of a gas containing hydrogen and oxygen, and by so doing cause a partial combustion of any hydrocarbons that may be present. It is important, therefore, that the palladium should be distributed as uniformly as possible throughout the asbestos. As a result of the ignition, after impregnation with palladium chloride solution, the asbestos becomes somewhat more rigid and the bundle of fibers may be readily pushed, by help of a copper wire, far into the narrow glass tube.

An Integrating Power Meter.[2]

[Abstract of a Thesis by Theo. Brown and Evarts Green Loomis of the Class of 1901, Worcester (Mass.) Polytechnic Institute: Edited by Professor Sidney A. Reeve.]

The industrial world feels a frequent need for a means of measuring the power transmitted from one point to another. When the transmission is electric, hydraulic, by compressed air or by gaseous fuel, the seller finds ready to his hands devices more or less simple and practicable which can be purchased and applied. But if the transmission be mechanical in form, the earliest and, apparently, the simplest of them all, the problem appears to be much more difficult. Of laboratory instruments there is a host of designs. Most of them measure only the torque passing the point in question: a few of them integrate with the velocity, as well. Most of them are quite accurate by nature and a few of the best of them are capable, by means of frequent calibration, of work of the most refined character. Of commercial designs, purchasable on the open market, however, there are very few. The best known locally, the Emerson "Power Scale," measures torque alone.

The question regarding such a commercially practicable instrument

1. A silvering mixture may be prepared according to the following formula: Dissolve 8 grams of silver nitrate, 10 grams of potassium cyanide, and 0.5 gram of potassium tartrate in 100 cc. of water. Add sufficient French chalk to make a thin paste. This mixture, applied with friction by help of a piece of Canton flannel, will produce a highly lustrous silver surface upon brass or copper.

2. *Jour. Worcester Poly. Inst.*

was brought to a focus, in this Institute, by the opening of the power house, some 5 years ago, for the supply of heat and power to the Washburn shops, the Department of Electrical Engineering and the Engineering Laboratories. To these duties it has recently added the heating of the Salisbury Laboratories. The need for constant knowledge of the power delivered to the shops made itself felt immediately. A small sum of available money presenting itself, students were set to work upon the construction of a power meter which should record the power delivered, measured in total horse power hours. The money was exhausted before the instrument was complete; one set of students after another did something to further the construction, but it was not until the spring of 1900 that it was first set in operation. The recording mechanism then proved to be inadequate. The reconstruction of the latter was then undertaken by Messrs. Brown and Loomis of the Class of 1901, as their thesis-task, and has finally resulted in a practical machine which is now in continuous operation on the shaft in the tunnel between the power house and the Washburn shops. While the design could obviously be improved upon in a second construction, and while time is yet lacking for refined investigation of its accuracy, the instrument stands to-day as a complete and successful one and as another monument to the practical value of the skill of the Institute's students.

In projecting the design the following prime desiderata were taken as premises:

1. Commercial applicability to any form of shaft transmission of power;
2. Integration of torque and velocity into horse power hours;
3. An accuracy which, although impossible of refinement owing to the rough nature of the conditions and impracticability of calibration, should yet be independent of speed, *i. e.*, of centrifugal force;
4. Practicability up to considerable powers.

The first requirement means that the instrument must be applicable to a line of shafting: (1) Without taking it down; *i. e.*, everything must be split. (2) With either side as the driver and either as the driven, or with the recording mechanism on either side, according as space be available; *i. e.*, the instrument must be independent of direction of transmission of power and of direction of rotation. These specifications fulfilled, together with (2), it is obvious that the instrument, once erected in any position, becomes capable of correct integration of all power transmitted from a source (*A*) to a destination (*B*) at any speed whatever, whether

A drive *B* forward (power positive),
A pull *B* backward (power positive),
B pull *A* forward (power negative), or
B force *A* backward (power negative).

While these possibilities are not ordinarily demanded of a power meter and were included solely for the sake of universal adaptability, yet not only do they broaden its fitness for all sorts of power measuring tasks but it has already developed from the limited use to which the meter has been put that in the routine case of transmission of power from an engine to a lot of mill shafting the transmission is very often momentarily negative. The least that can be said is that the percentage of variation in the power passing any point near the engine is very much greater than that of the load itself. The instrument which is not designed to take proper cognizance of all these variations is very apt to fail in attempting to average them.

The general design is plain from the half-tones, Figs. 1 and 2, the former being from the driver and the latter from the driven side, as the machine is now erected. The driver carries, bolted and keyed to the shaft, a pair of massive cast iron arms, lying horizontally in the photograph. The driven shaft carries a similar pair sensibly at right angles with the first pair. Each arm carries at its extremity a pin which forms a journal for a roller bearing and its casing. Each cast iron casing extends so as to form a nut upon which is threaded the end of a helical spring. The driven shaft is loosely centered in the hub of the driver arms, so as to maintain alignment and support the weight. Thus the torque transmitted from driver to driven finds expression in the distortion of the springs and the relative angular displacement of the arms. Each hub is provided with a pair of heavy projecting bosses so that in case of the failure of the springs or pins, or even of the arms themselves, the power will still be transmitted, as through a 2-jaw clutch coupling. These bosses also serve to protect the springs from over-distortion.

The angular displacement of the arms gives rise to relative motion of two rolling cams, seen in Fig. 1, which are prevented from slipping by wire cord connection. This, in turn, operates the bevel gearing seen in Fig. 2. The little oblique shafts impart axial motion to the cylindrical

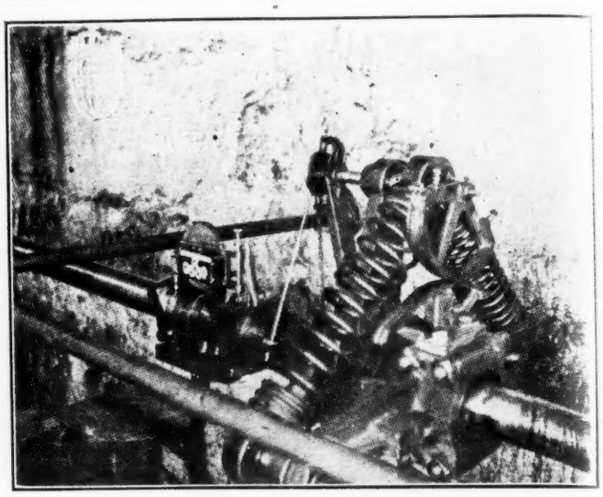


Fig. 1.

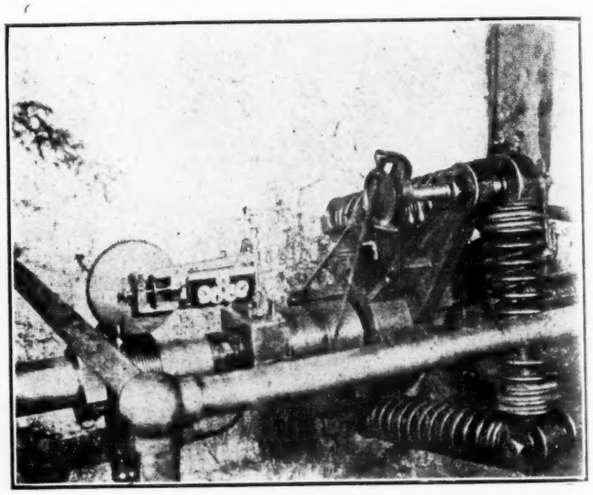


Fig. 2.

rack which surrounds the shaft, sliding upon it and carrying the recording dials, which are of the ordinary gas meter type.

Clamped to the shaft at the extreme left is a split collar carrying a worm thread and also restraining from axial displacement a hanging construction which carries, above, the journal support for the worm disk and, below, a guide parallel to the axis, in which guide runs freely a roller connected with the cylindrical rack.

Below the guide the hanging construction extends in the form of an arm to the floor, where it is loosely restrained from motion. The result of all this is that the disk is rotated slowly by its worm connection with the shaft, while the rack is prevented from rotating with the shaft which supports it, yet is free for axial displacement relatively to the disk in response to the angular displacement of the arms. This axial movement of the rack carries the little integrating roller, visible in Fig. 2, across the face of the disk, on one side of the center of which it receives positive motion on the other negative.

The disk brings to the roller the velocity of the shaft, whatever it be, positive or negative. The displacement of the roller from its center measures the torque with great delicacy, because the motion of the shaft beneath the rack permits the latter to respond to the slightest touch of the springs. Because there is no appreciable resistance the mechanism between arms and rack offers no appreciable friction. The roller bearings on the pins are subject to heavy pressure, but are well constructed and suffer very slight angular motion for considerable relative displacement of the arms. The only possible point where appreciable friction might be expected is where the driven shaft is centered in the driver's hub; and here, since only weight is to be supported and there is plenty of jar to overcome static friction, only bad workmanship can develop it.

The security from error due to centrifugal force is omitted from the present construction, because the speed is moderate. For high speed the middle of each spring is loosely encircled by a band and the 4 bands

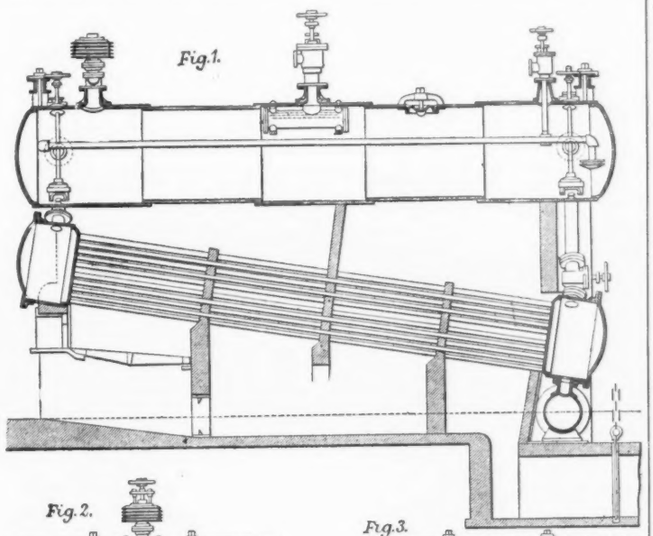
are connected by 4 pairs of light links which form a square when the torque is zero and a rhombus when the arms are distorted. The links are in tension; there is no motion between bands and springs; the resistance to distortion is very slight. Yet the springs are protected from buckling or bowing due to centrifugal force.

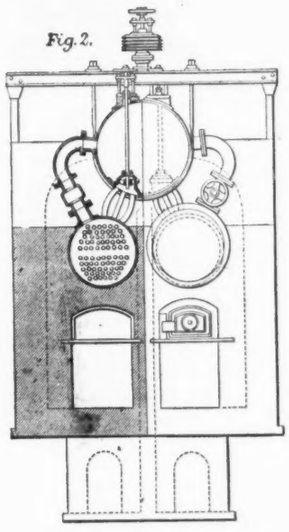
The instrument shown has a capacity of about 20-horse power per 100 revolutions per minute. The arms are 12 inches long to center of pin; the springs are 3 inches in diameter.

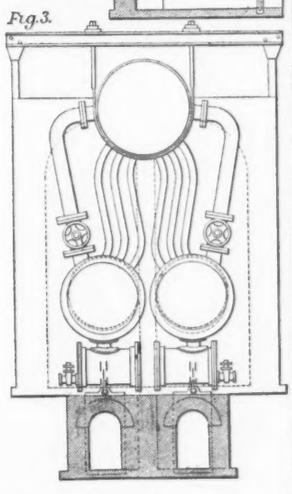
As soon as funds are available for the construction of a second power meter like the above, and for one more water meter, the "Power House," which keeps a log of its daily doings for the instruction of the students, will be in a position to know accurately the destination of all the power and heat which it at present puts out, in seven or eight directions in all.

Penman's Water Tube Boiler.

The illustrations show a water tube boiler designed by Mr. William Penman, a member of an important firm of boiler makers in Glasgow, Scotland—if we mistake not the commercial name of the concern is that of the Caledonian Iron Works—to run its works machinery. As







one would naturally expect, in view of the fact that Messrs. Penman confine themselves to the making of boilers, leaving others to construct the machinery, the steam generator is essentially a boiler maker's job. Indeed, one of its characteristics is its simplicity, while it contains more water than is usual with tubular boilers. All the tubes are drowned, so that circulation may be as rapid as the stoking requires. There is the usual steam collector or drum at the top, but instead of the tubes, which are inclined slightly to the horizontal, being screwed into junction boxes, or expanded into vertical tube plates at front or back, forming headers, they are expanded into end chambers, of which there are two at both front and back of the boiler. These, as shown, are circular and of considerable length, built of a flanged tube plate and a circular body, with an angle steel flange for securing the dished plate in front, which forms a manhole in smaller boilers or has a door in larger boilers. There is thus no trouble in removing a tube or of plugging it in the usual way, while the nest of tubes to which the injured pipe belongs may be stopped for the repairs.

This method of isolating part of the heating surface is one of the features of the design. It will be seen that there are two groups of tubes, with separate drums at front and back. The connection between the upper and the lower drums is through a series of curved tubes passing from the bottom of the upper to the top of the lower drums, and these tubes, which also are simply expanded, can be stopped by a lift valve fitting in a seat chamber within the upper drum and lowered or raised by a spindle extending through the top of the drum and fitted with a handwheel. In this way it might be possible to work one-half of the boiler while withdrawing a defective tube and expanding a substitute. There are also two outside circulating tubes, connecting with the upper drum above the water line, and these are fitted with a stop valve for shutting off connection. Under the drum at the back of the boiler there is a mud drum with the usual blow out cock.

The general arrangement is very simple, and although the boiler at the Caledonian Iron Works is not worked at a very high pressure, or to give forced results, it has done good work, according to the requirements, without indicating any weak element in design.

Coal and Ash Conveying Gear.

By Mr. R. A. Chattock, Bradford, England.

The question of dealing with coal used in electric generating stations is one of the most important that presents itself to the electrical engineer and of almost as much importance is the question of disposing of the ashes that are produced by the boilers. Taking the average of a number of works the cost of the coal works out at 1.42 cents per unit, and this represents 46.6 per cent. of the average works cost per unit. In a station producing 5,000,000 units per annum this means an expenditure of $73,955 per annum, or at an average rate of $3 per ton, a consumption of 24,652 tons per annum. The cost of conveying and handling this coal varies between very wide limits, according to the distance it has to be taken, the height to which it has to be raised, and the means at disposal. As a rule coal contracts are drawn up to include the cost of cartage into the generating station, and it is consequently somewhat difficult to give an exact figure for this item. A charge of 12 cents per ton for cartage from an ordinary railway siding for a distance of half a mile is however a fair estimate. This represents an annual cost of about $3,080 on the above quantity of coal.

If it is possible to put in a conveying apparatus that will take the coal direct from a railway or water siding and deliver it to the generating station, and if the annual charge on this, represented by say 10 per cent. on the prime cost of the apparatus, does not exceed the above amount, it is certainly worth while to adopt this principle. If, however, the distance is great between the siding and the station, and cost of the apparatus excessive, it is better to have the coal carted to the generating station and distributed in the coal bunkers by means of a local conveying apparatus.

Horse traction for cartage purposes is a very unreliable means, especially in winter time when the frost is on the ground and when it is very important that there should be no interference with deliveries, and on this account, and also that the cartage may be under the direct control of the station engineer, a more reliable means should be provided. This may be effected by means of motor driven trolleys, each capable of holding about 5 tons, so constructed that they can be backed under the coal drops of a railway siding or under the cranes used to unload a barge, and arranged so that they can be tipped into convenient hoppers in the generating station. Such vehicles can travel at a speed of 8 miles an hour, and when not used for coaling purposes can be utilized for conveying cable drums or other heavy gear about the town. They should be preferably station driven, and can be purchased for $2,500 to $3,000 each.

Once the coal has reached the station the question of the most convenient means of storage presents itself to the engineer. The minimum amount which should be stored in a station is 100 tons for every 1,000 indicated horse power installed, and this amount can be conveniently contained in overhead bunkers placed above the boilers. It is, however, desirable to store four or five times this amount if possible, and to effect this an auxiliary coal store is necessary. This must obviously be placed outside the boiler house. It should be near the ground level and

connected to the overhead store by means of conveying and elevating machinery.

The coal store or bunkers, whether overhead or on the ground level, may be constructed of brick or iron work. The flooring should be sloped at an angle of 45° to points in the center, from which distributing shoots can be taken either to supply the boilers or the conveying apparatus. The maximum depth of the coal stored in such bunkers should not exceed 10 feet. If this is exceeded the coal is liable to become overheated and to catch fire.

The construction of the bunkers, including the roof work, should be entirely of non-combustible material, and fire hydrants should be placed in accessible positions. In an auxiliary coal store it is usual to have a conveyor running over the top of the store and returning underneath it. By means of this the coal can be collected from the points where it is discharged from the carts and can be distributed in the store. If it is desired to draw coal from this store the return half of the conveyor, which runs beneath it, can then be fed by shoots, and arranged so that it will deliver to an elevating apparatus. The elevating apparatus should take the coal to the level of the coal bunkers over the boilers, and it should be possible to feed this either from the auxiliary coal store or direct from the carts. After the coal has been elevated to the desired height it can then be distributed in the overhead bunkers by means of another conveying apparatus, and from these bunkers it should be fed to the boilers through shoots, which should be fitted with controlling valves.

They are many forms of conveying apparatus and I will endeavor to describe those most in use, and point out their advantages and defects.

The worm type of conveyor consists of a worm or screw which revolves in a semi-circular trough. The coal is fed into one end of this trough and is gradually pushed along by means of the worm; it is allowed to fall through doors in the bottom of the trough, which can be opened when necessary. This apparatus can only deal with small coal, and it is very liable to get out of order owing to lumps of coal becoming jammed between the worm and the trough. The power taken by this apparatus is also excessive owing to the friction between the worm and the coal, and between the coal and the sides of the trough.

The chain type of conveyor consists of a chain formed of lines of bar iron riveted together; this is dragged along a flat bottomed trough having doors on the underside; the chain passes over a sprocket wheel which is driven by gearing, and is dragged along the trough, pulling the coal with it. This conveyor is less liable to get out of order than the worm conveyor, but the friction between the chain and the trough and the coal and the trough is excessive. Another objection that this conveyor has is the fact that the rivets in the chain, which form the pins on which the links turn, are buried in the coal, and in time these and the holes in the links become worn and cut away; the centers of the links consequently become elongated and the chain does not gear properly with the sprocket wheel. The life of such a chain is not more than from three to four years.

The push plate type of conveyor was devised with the idea of keeping the chain itself out of the coal. The chain of this conveyor runs on rollers above the trough, and attached to it are a series of rectangular plates which dip down into the trough and push the coal along as the chain is dragged forward. This is a better form of conveyor than the last, but it has the same objection owing to the excessive power absorbed in the friction of the coal when being dragged along the trough.

The band type of conveyor consists of a broad, endless indiarubber or fiber belt, from 18 inches to 24 inches in width, running over pulleys at either end, and supported by rollers throughout its length. These rollers are shaped or inclined so as to cause the belt to sag in the center and so prevent the coal from falling off. In order to discharge the coal from the belt the latter can be tipped on one side at any desired point, and the coal will fall off the other side, or the coal may be scraped off by an inclined scraper placed at any point. This form of conveyor takes less power to drive, and there is no power absorbed in friction as described in the previous types. This type of conveyor has the advantage of being about the cheapest in first cost, and rubber belts such as these have been known to last from 10 to 12 years, and even then to be in a very fair condition. The working parts of the apparatus can be lubricated, preferably by means of grease.

The steel trough conveyor is composed of a number of steel plates, which are usually turned up at the edges, and which are fixed to the links of an endless chain. The chain may be run on rollers or may be fitted with small flanged wheels, which run on a tramway. The plates are so arranged that when the chain is approximately in a straight line they form a continuous trough, which travels along. The coal, which may be of any size, is fed on to this trough and carried along by it to any desired point, where it can be discharged. It has the advantage that the working parts of the chain are kept away from the coal dust, and there is no power absorbed in friction, the coal being carried along bodily. The conveyor is not, however, adapted for the convenient discharge of the coal at any point along its route. The return chain also is useless.

All the above types of conveyors can only be used for conveying coal approximately horizontally, and if used for elevating they should not be run at a greater angle than 30° with the horizontal.

Another type of conveyor that is being extensively adopted now is one in which the coal is conveyed by buckets which are hung on an endless chain. These buckets always hang vertically, and in this way the conveyor can be used either for conveying horizontally or elevating vertically, or at any desired angle. The chain itself is fitted with small flanged wheels, which run on an ordinary tramway composed of T-section rails. Where it is necessary to change the direction of the motion from conveying horizontally to elevating vertically, curved rails are fitted to effect this.

The chain is a double link chain on each side of the buckets, and the driving is effected by means of toothed wheels or pawls, which engage with distance blocks fixed between the double links. This conveyor can only run in a straight line when moving horizontally, but the direction of the motion may be changed to one at right angles if desired, where the chain is ascending or descending vertically, by allowing the chain to twist where it is hanging free. The buckets are filled by means of funnel shaped spouts which fit into them as they pass along, and each spout allows just sufficient coal to enter in order to fill the bucket. This conveyor takes very little power to drive it, as there is only the friction in the wheels to overcome and the dead weight of the coal to be raised. It is so free that the weight of the coal in the ascending buckets is enough to cause the chain to run backwards if the driving power is taken off, and means have to be taken to prevent this by using a ratchet and pawl. The working parts are protected from contact with the coal or ash dust, and in consequence have a maximum life. The buckets can be tipped at any desired point by means of a lever engaging with a pin on the side of the bucket. This conveyor can be used both for coal and ashes if it is arranged to travel over the coal bunkers and under the ash pits of the boilers, and in this way the cost of installing two conveyors and special elevating gear is obviated.

Another type of conveyor and elevator that may be employed is as follows:

A long girder of H section is supported at any desired height by means of lattice framework and tie rods. On this is fitted a trolley which can be pulled backwards and forwards by a wire rope; on this rope is a pulley with a hook attached, and at certain points this hook can be lowered to the ground level, where a skip, holding about a ton of coal, can be attached to it. The skip is then raised, and when the hook is brought to the level of the girder it is gripped by the trolley, and the whole is travelled along; the skip can then be tipped at any desired point. The motion is then reversed, the skip brought back again, lowered, unhooked, and a fresh skip attached. In this method it is necessary to fill the skips by hand; they can, however, be emptied at any desired point. The working parts are kept free from coal and ash dust, and the apparatus does not take an excessive amount of power to drive.

Turning now to elevators as distinct from conveyors. The most usual type adopted is that having an endless chain, which passes over pulleys at the higher and lower level, and has buckets fixed to it. These buckets dig into the coal at the bottom end, in what is called the boot of the elevator; they carry the coal to the top, and as they turn over the top pulley they discharge the coal down a shoot, which, as a rule, feeds on to a conveyor. This form of elevator takes a considerable amount of power to drive it, and it has the disadvantage that the working parts of the chain come into contact with the coal or ash dust, and in consequence wear takes place.

For unloading coal from a barge the best form of elevator is an automatic grab which can be attached to a crane. This, while open, can be dropped into the coal, and as the lifting chain begins to pull, the grab closes, digs into the coal and fills itself. It can then be lifted to any desired height and discharged into a hopper, from which the coal can be taken by the conveyor. If desired each grab can be weighed, and an automatic register kept of the weight.

Conveying and elevating apparatus is peculiarly liable to breakdown, owing to the rough nature of the work it has to do, and in order to guard against the serious results which a breakdown may entail during the heavy winter loads, some duplicate means should be provided for getting coal into the station and for getting the ashes away from it. Owing to the high initial cost of a good conveying plant it is not advisable to install this in duplicate unless the station be very large and

the outlay be warranted. It would appear best to use some simple and effective means, such as a system of light tipping trucks which can be run on a tramway in the boiler house and which can be filled by hand. Such an arrangement of course entails a considerable amount of labor, but being only a stand-by, and to be used only in an emergency, this item cannot amount to very much. In some cases means may be provided for taking the coal carts themselves into the boiler house and dumping the coal on to the floor.

With reference to ash conveying, the same type of apparatus can be used as is employed for coal conveying.

The ashes should not be allowed to interfere with the handling of the coal in any way, and should, if possible, be dealt with in a cellar below the boiler house flooring. In a boiler house containing a large number of boilers, if the ashes are allowed to accumulate, even for a couple of days, the whole place becomes so choked that it is impossible to work the boilers properly, and if there is a large space available below the floor the ashes can be allowed to accumulate here for several days if it is impossible to get rid of them. The ashes should be taken to an overhead bunker, preferably at the end of the boiler house furthest from that at which the coal enters, and from this bunker they may be fed into carts or trucks by means of shoots. It is most essential that they should not be allowed to accumulate, and it is quite as important to provide duplicate means for getting rid of them as it is for getting the coal into the station.

[Concluded from Vol. LXXIV.—Page 730.]

Further Notes on Purification of Gas.[1]

By Mr. S. Carpenter, of East Ham, in *Jour. of Gas Lighting*.

In testing for sulphur according to the method already described, the author found that the difference in the results obtained, due to variations of the thermometer and barometer, was so small that, to save time, he did not trouble to make the correction. For example, with the thermometer at 60° F. and the barometer at 30 inches (the standard temperature and pressure), of course, no correction is required; but if the temperature falls to 52°, and the pressure to 28.1 inches, the tabular number is 0.955. The result of the sulphur test being 12 grains per 100 cubic feet, it would be increased to 12.5 grains—a difference of ½ a grain. On the other hand, supposing the barometer remains at 30 inches and the thermometer falls to 46°, the tabular number is 1.025, and the sulphur is, as before, 12 grains. This would, by correction, be decreased ½ grain, making 11.5 grains. The question then arises whether it is worth while to waste valuable time for nothing.

As a comparison between the method of testing previously described and the boiler process as prescribed by the Gas Referees, I have made a series of tests by both methods upon the same liquid resulting from a sulphur test under precisely similar conditions. The following figures show the closeness with which the results approximate:

Referees' Method.	Carpenter's Method.
13.5 grains per 100 cu. ft. of gas.	13.9 grains per 100 cu. ft. of gas.
13.7 " " "	13.2 " " "
13.2 " " "	13.2 " " "
14.4 " " "	14.9 " " "

It will be seen by these figures that the average of the latter method is slightly higher than the former; showing that the cold process tends to extract the sulphur to the utmost extent rather than otherwise, which, it will be admitted, is a merit.

By using what I have called the "cold" process, and also my table, the necessity for any calculation on the part of the operator is obviated; and as the figures have been carefully worked out, they may be depended upon for accuracy. For the benefit of those who may read this article, I have prepared a synopsis of the table, and by observing the quantity of gas consumed in the test, upon reference to it the number of grains of sulphur contained in 100 cubic feet may be ascertained. It is intended more especially for the use of those gas examiners who are not qualified chemists, or who, owing to want of time and pressure of other duties, are desirous of simplifying the process of testing.

A little explanation of this table will not be out of place. Supposing 5 cubic feet of gas have been consumed in the sulphur test, and 1,000 grains of the liquor have been analyzed, and 0.1 grain of barium sulphate obtained in the test, upon reference to the table, under 0.1 grain, the figures 2.4 will be found, which will represent 2 grains and 0.4 of a grain of sulphur in 100 cubic feet of the gas tested. Then 7, 8, 9 and 10 cubic feet are worked out in the same way as 5 feet, according to the quantity of barium sulphate found in the test.

Where gas has to be tested for carbonic acid and sulphuretted hydrogen, two test cocks are used in each purifier—one being fixed in the middle of the vessel, just above the second tray of lime, counting from the bottom, and the other in the cover. The gas should be tested twice a day by lime water at each of these cocks for carbonic acid. The gas should be passed through oxide of iron in a small hand purifier, to remove the sulphuretted hydrogen, before being tested. If this is not done, the test will lead the operator astray, as lime water will take up a portion of the sulphuretted hydrogen, and this will turn it a brown color, so that it would not show the presence of carbonic acid so quickly. Take a small quantity of lime water in a beaker, and let the gas bubble through it for about 3 minutes. If there is any carbonic acid in the gas, it will make the water become milky. There is no need to test for sulphuretted hydrogen at the first lime purifier, because we know it is there; but testings should be made for it at the second lime purifier, both at the middle and at the outlet.

When testing gas for sulphuretted hydrogen, it must not pass through oxide of iron. It should be tested by letting a stream blow upon a piece of paper moistened with acetate of lead. Should sulphuretted hydrogen be present, the gas will turn the paper a brown color in a quarter of a minute. It is necessary that the gas should be tested for sulphuretted hydrogen to ascertain if there is sufficient in the gas to keep the lime in the second purifier in a state of hydrogenated sulphide of calcium, which has the power in a high degree of absorbing bisulphide of carbon. The gas should be tested for bisulphide of carbon at the inlet and the outlet of the first purifier, and also at the outlet of the second lime purifier. The results will give the number of grains of the impurity in 100 cubic feet. If the percentage of carbonic acid and sulphuretted hydrogen is required, the gas must be tested by the eudiometer, which has already been explained.

The object of the hydraulic main, the dip-pipes, and the condensers is to prevent the gas from returning through the ascension pipes to the retorts. The dip-pipes should have a seal of tar from 1 inch to 1½ inches deep, so that the gas may pass through the tar, as this is the first stage in the process of condensation and purification. The gas and the tar should not be separated before they reach the condensers. "Condensation" is the reduction of anything to another and denser form, as of a vapor or a gas to a liquid, a liquid to a solid, or the passage of gases or vapors from the aëriform to the liquid state. It is sometimes called the "liquefaction of vapors." It may be due to one of three causes—cooling, compression, or chemical affinity. The first we may count upon for the condensation of the vapors intermixed with the gas when issuing from the hydraulic main, into ammoniacal liquor and tar, by which process the latter is prevented from passing forward to the other apparatus. The condenser also serves to reduce the temperature of the gas to the degree most favorable for depositing its ammonia in the washer or scrubber. If the gas is well washed in tower scrubbers with ammoniacal liquor and fresh water, the ammonia (NH_3) and part of the carbonic acid and sulphuretted hybrogen will be taken out; and the gas which issues from the scrubbers will then be in a good condition to go into the lime and oxide of iron purifier where its remaining impurities, which include bisulphide of carbon, will be removed, as previously explained.

The object of the exhauster is to remove the gas from the retorts as quickly as possible, so as to relieve them from back pressure. Before the exhauster was introduced, the gas was subject to excessive pressure

Cubic Feet of Gas Burnt.	Grains of Barium Sulphate Obtained in the Test														
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
5	2.40	4.80	7.20	9.60	12.00	14.40	16.80	19.20	21.60	24.00	26.40	28.80	31.20	33.62	36.00
7	1.72	3.44	5.16	6.88	8.60	10.32	12.04	13.76	15.48	17.20	18.92	20.64	22.36	24.08	25.80
8	1.50	3.00	4.50	6.00	7.50	9.00	10.50	12.00	13.50	15.00	16.50	18.60	19.50	21.10	22.50
9	1.33	2.66	3.99	5.22	6.65	7.98	9.30	10.64	11.97	13.30	14.63	15.96	17.29	18.60	19.95
10	1.20	2.40	3.76	4.80	6.00	7.20	8.40	9.60	10.80	12.00	13.22	14.40	18.62	16.80	18.00

1. The author prepared these articles expressly for students and young gas managers.

during the process of carbonization, arising from the action of the different apparatus employed in the manufacture of gas—from the dip-pipes in the hydraulic main, which were sealed by the tar, the resistance to which the gas was subject in passing through the purifiers, or the effect of the weight of the gasholder. After the introduction of the exhauster, the pressure was taken off the retorts, the hydraulic main, and the condensers; and there was no need to counterbalance the gasholders. Instead of pressure, a little vacuum was possible on the condensers and the hydraulic main, the pressure could be reduced by the exhauster, and if there was about an inch of vacuum instead of pressure, the deposit of carbon on the interior of the retorts was much reduced. The position occupied by the exhauster is between the condenser and the scrubber. The outlet of the condenser should be connected to the inlet of the exhauster; and the outlet of the latter to the inlet of the scrubbers. There would then be vacuum on the condenser and pressure on the scrubber. Before exhausters were introduced into gas works, the evils engendered by back pressure on the retorts were many. First of all there was a deposition of carbon on the inner surface of the retorts; secondly, a diminished quantity of gas per ton of coals; thirdly, the space occupied by the carbon deposit reduced the capacity of the retorts, and consequently the charge of coal; lastly, the expenses of wear and tear and labor were increased.

For the reasons stated, the exhauster is one of the most important appliances employed in the manufacture of gas; and gas managers should look upon it and the hydraulic main as two of their best friends. The latter acts as a condenser, and to a certain extent also as a purifier, and likewise as a tar valve, as, the dip-pipes being sealed with tar, the gas is prevented, as already explained, from returning down the ascension pipes during the time of drawing and charging the retorts. The exhauster does two things at the same time—it exhausts the gas from the retorts as quickly as it is made, and forces it through the purifier to the holder. Before its introduction, the heat of the retort had to do its work. One form of this appliance is called the "steam jet" exhauster. It is very useful in gas works, especially for ventilating the lime purifiers, and at the same time revivifying the foul lime before it is taken out. The purifier may then be emptied without fear of creating a nuisance during the operation. When the foul lime is prepared, it can be used a second time for the purification of gas; thus reducing the expense, as less clean lime will be required, and not so much "spent" will have to be disposed of.

In connection with the subject of the purification of gas, it may be useful if I now describe the way in which I worked the sulphur when I commenced experimenting on coal gas for the detection of bisulphide of carbon in the year 1866–7. The rules I laid down were the following: Record the time the gas is lighted up and extinguished, the hours the test is in action, the quantity of gas burnt, the water produced from condensation, the water per cubic foot of gas, the sulphate of barium found in 1,000 grains of the liquor tested, and the sulphur in 100 cubic feet of the gas tested. Some of the results are recorded in the following table:

Time Lighted.	Time Extinguished.	Hours Burning	Gas Burnt.	Water Produced.		Barium Sulphate	Sulphur.
May, 1867.			Cub Ft.	(a)	(b)	(c)	(d)
9th, 2 p.m.	10th, 7 a.m.	17	13.0	4,600	360	3.8	18.40
19th, 2 p.m.	20th, 7 a.m.	17	13.0	4,800	377	2.2	16.52
20th, 6 a.m.	21st, 7 a.m.	23	19.0	7,000	370	2.6	13.32
23rd, 8 a.m.	24th, 7 a.m.	23	18.5	7,000	384	1.8	8.66
25th, 3 p.m.	26th, 2 p.m.	23	18.5	7,100	380	2.4	12.67

(a) Grains. (b) Grains per cubic foot of gas. (c) Grains in 1,000 grains of the liquid. (d) Grains in 100 cubic feet of gas.

In testing the gas for bisulphide of carbon, great care should be taken at the outset that all parts of the apparatus are perfectly clean, and in good working order. Next, the operator should see that the water in the meter is level with the water line, that all connections are gas tight, and that the rubber joints of the trumpet tube and cylinder fit closely. He should guard against draught, which may extinguish the gas jets. Sufficient sesquicarbonate of ammonia (about 2 ounces) should be placed around the burner, the gas lighted, and the test set to work. With these precautions, and with subsequent careful manipulation of the liquid, the results obtained should be reliable. By noticing the time the test is in action, it will be seen if the gas has been properly burnt; and the operator should see how much gas has been burnt in making the test.

The beaker which receives the condensation water from the cylinder should be graduated in grains and hundredths up to about 10,000 grains. When the meter is shut off, the number of grains of liquor in the beaker should be noticed, and the register of the meter taken, in in order to ascertain how many feet of gas have been burnt in the test. A comparison should then be made with the water in the breaker. The condensation from 10 cubic feet of gas in summer will be about 3,700 to 3,900 grains; but it will depend upon the temperature prevailing while the test is in action. In the summer, when the air is dry and the temperature about 60 F., each cubic foot of gas will produce from 340 to 360 grains; in the winter, it will be from 380 to 400 grains. The object in registering the liquor per cubic foot of gas consumed in the test is to indicate whether or not the gas is properly burnt while the test was in action, as there is a possibility of the gas escaping at the base of the burner. It would happen in this way: The horizontal piece of tube which screws into the base of the burner may leak; and if the gas should escape at that place, it would be registered but not burnt, and the sulphur would then appear very low, and the liquor would be less per cubic foot of gas and of a dark color, like whisky. The writer has had these troubles when he has been testing gas, so he can point them out for the benefit of others. By measuring the condensation liquor it will be seen at once if the sulphur test is working properly. He has worked the sulphur test in the way described, and can recommend it for keeping the manager well informed as to the condition of his purifiers. If the method which has been described is properly carried out in purifying and testing, there will be no difficulty in removing the impurities from coal gas. The principal object to be sought at the present day is to fully utilize and improve upon the existing process of purification. This can be done, and the process be made to yield satisfactory results with lime, oxide of iron, and atmospheric air. The writer worked for 30 years in the way he has described, and obtained good results.

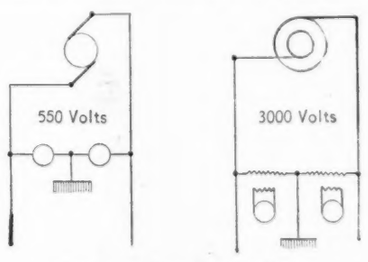
A few words, in conclusion, on slaking lime. It has been said that lime which is to be used in the purification of gas ought not to be slaked until immediately before being put into the box, as slaked lime absorbs carbonic acid from the air, whereby its beneficial action upon gas is impaired. The writer has not found this to be the case in his experience. The most practical way to slake lime is as follows: Spread it on the floor to a depth of about 6 inches, and then water it. Spread another layer of lime on the top, and water it, and continue adding until the heap is 3 feet high. Allow it to remain for about 24 hours, and then well mix it. Let it get cool before putting it into the purifier; if it remains for a week or two, it will not take any harm by being exposed to the air. Hot, or even warm, lime should not be put into the purifier, as it is liable to cause what are called "blow holes," through which the gas would pass without being purified. As to exposure of the slaked lime to the atmosphere causing it to absorb therefrom carbonic acid sufficient to impair its action as a gas purifying material, the process would take years, as the proportion of carbonic acid is generally about $\frac{4}{10000}$ of the whole volume of the atmosphere. When the lime is prepared for the purifier, it should be soft to the touch, and when squeezed in the hand should adhere. The weight should be from 32 lbs. to 34 lbs. per bushel. Great care should be taken, when slaking lime, not to use too much water; otherwise the lime will cake together, causing back pressure, and not absorbing the bisulphide of carbon.

A True Ground Detector.

By Mr. T. W. Varley, in *Elec. World*.

A ground detector, as the term is generally understood, is really a "balance indicator." In the first place, it should be understood what is meant when a circuit is said to be "grounded."

Take the 550-volt underground system of the Metropolitan Railway, where the two contact rails are insulated. An ordinary, so-called "ground detector" is installed consisting of a bank of lamps across the line, with the center grounded, as in Fig 1. As long as the two legs of



Figs. 1 and 2.—Ground Detector.

the circuit have the same resistance to earth, the two lamps burn equally, even though the actual insulation resistance varies from

nothing to a megohm. But let one leg differ from the other and the lamps then begin to show this difference, proving their value only as a balance indicator, and not as a "ground detector."

Take an opposite case, using an alternating current of 3,000 volts feeding through lead covered underground cables. On account of the high voltage, transformers are used with the lamps in the secondary of each transformer, as in Fig. 2. In this case, by simply varying the length of cable in one leg so that the capacity of one leg is different from that of the other, the lamps will show the unbalanced effect, proving again their value only as a "balance indicator."

These are a few of the reasons which led up to the design of a true "ground detector," which would indicate some definite lowering of the insulation resistance, so that if a standard were determined upon, then when the resistance fell to this value an alarm would be sounded.

While serving its purpose as a very efficient and faithful "ground detector," it also acts for the regular insulation testing to determine the actual resistance to earth of the system, and also to send messages between different points of the system. This will be explained in the description of the detector.

To best describe it, I will give as near as possible the actual figures of the resistances, etc., arranged to suit the local conditions at the station where it is in use.

Starting at the "exciter" end, in Fig. 3, there are three machines, which are permanently electrically connected on the negative side by the equalizer wire. The positive side of the bus is grounded through lamps. The negative side goes through similar lamps, and then the circuit divides. One section goes through a 150-ohm relay and resistance of 10,000 ohms to the center of a double throw, double pole switch. The other section goes direct to the opposite top contact of the same switch.

In normal condition, or when acting as a ground detector, this switch is closed on the upper contacts, as shown in dotted lines. This throws the first or relay section to ground, and the second section to a choke coil, having a resistance of 490 ohms, then to a fuse to a plug P, and so to the 3,000-volt bus.

With this plug out, the tension of the armature of the relay is adjusted to fall back when P is grounded through the resistance decided upon as the standard at which an alarm is to be given. As the alarm is sounded when the potential across the relay falls, this is caused by the standard decided upon being in shunt to the relay, and its extra resistance, in combination with the lamps, causing the potential across the relay itself to lower. For example, the volts applied are 260; the lamps are six, of 200 ohms each, or 1,200 ohms; the relay and resistance 10,150 ohms, and the choke coil and standard 490 ohms plus 20,000 ohms, or, say, 20,500 ohms.

At first this standard circuit is open and the potential on the relay is $\frac{260}{1,200 + 10,150} \times 150 = 3.44$ volts. Next, the standard circuit is closed, when the potential on the relay becomes

$$\frac{260}{1,200 + \frac{10,150 \times 20,500}{10,150 + 20,500}} \times \frac{10,50 \times 20,500}{30,650} \times \frac{150}{10,150} = 3.27 \text{ volts.}$$

The alarm is an ordinary vibrating bell worked with 5 volts alternating, on the back contact of the relay.

If any part of the relay circuit opens the alarm rings; also, if any part of the "exciter" circuit becomes grounded other than that through the lamps. For if the ground comes on the negative side, the alarm rings immediately; if on the positive side of a machine while on the bus, no notice is given until that machine is taken off, when it becomes part of the negative side by way of the equalizer, and so gives the alarm. It acts also to test the fields of the alternating current generators by simply connecting the negative side first.

Thus it gives a constant automatic true ground test of all portions of the alternating current and direct current systems.

The outfit was originally designed for testing the insulation of the circuits, while working, not only to get a test under the conditions of the high tension strain, but to do away with the interruption of the service. At first a d'Arsonval galvanometer of 10,000 megohms constant was used, but as the insulation of the system ran about 200,000 ohms, this was changed to a Weston direct current voltmeter, making it much more convenient to use. A daily test is now made with no more trouble than reading the voltage of the circuits.

In Fig. 3 is shown the position of the voltmeter. When used for testing the switch is thrown down, putting everything in series, and the voltmeter then acts as a galvanometer or ammeter, reading the current through the insulation of the 3,000-volt mains.

The constant is obtained by grounding plug P, and the regular formula $R = r \frac{D\text{-}d}{d}$ is used. Here r represents the total resistance in circuit when P is grounded, or 30,000 ohms. D is the deflection obtained with P grounded, and d that obtained with P on the system. If D is 1.30 and d is 15, then R would be $30,000 \frac{130\text{-}15}{15}$, or 230,000 ohms.

At times the system will show a gradual falling off in insulation resistance, indicating a fault, which if left to itself would soon develop into a ground and lead to a short circuit. When this happens means are taken to locate the fault as follows:

The circuits are each taken and run on a special machine for testing without interruption to the service. Then the primary customers of the circuit at fault are tested. The testing of each customer is done at the station in quite a simple way. As the detector will ring when the insulation reaches 20,000 ohms, a bank of lamps is arranged as an artificial resistance for the party at the customer's end to send signals to the station as follows:

If the voltmeter at the station showed, for the whole service when normal, 15 divisions and when faulty 40 divisions, and if the fault was at some customer's, then if the primary switch is at that customer, the fault will disappear, or the deflection of the voltmeter will fall to 15 divisions. It would be very tiresome to have to watch the voltmeter for a whole day, and besides the switch is opened and closed quickly, no signals are arranged to be given just before and after the switch is operated, when a rest can be taken until the next customer is reached. In giving these signals the operator grounds the system by means of his bank of lamps, thus ringing the alarm at the station. He then pauses a second to give the station man a chance to cut in his voltmeter before working the switch of the customer. He then gives a second signal when through and notes the time. When the station attendant has cut the voltmeter in he watches until he sees the second signal, takes the time and then cuts in the relay and bell. The second signal throws the needle of the voltmeter to about 80 divisions. The time is taken to be able to tell when finished, which particular customer it was whose service is faulty.

If the fault is in the cable, it must be sectioned, which means a cut and test until found.

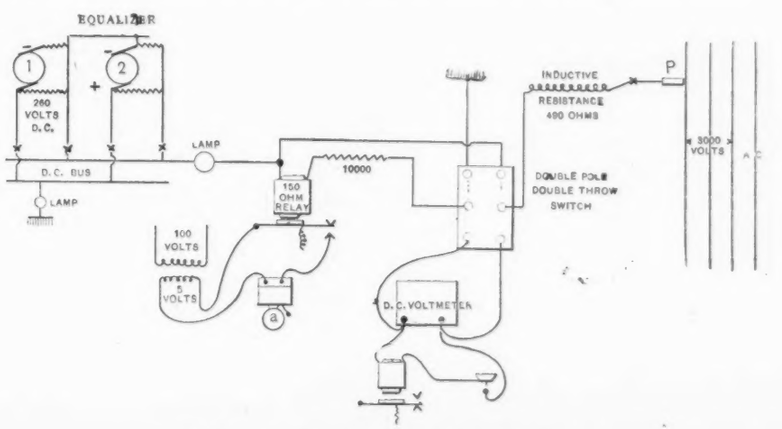


Fig. 3.—Connections of Ground Detecting Apparatus.

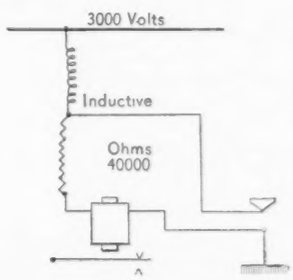


Fig. 4.—Diagram of Connections.

Since the installation of this system of testing and keeping on the lookout for trouble, it seems to act as a preventive, for there certainly has been far less trouble than before using it.

Another use for the detector is when the service must be interrupted for changes, etc. The time is usually selected in the early morning. A telephone booth may be miles away from the work, and even when found time is often wasted in getting connections. It then takes the place of a telephone and serves as a telegraphic connection between the station and the work. The workman has an outfit similar to that at the station, and signals on the ground bell. Instead now of using the voltmeter a regular sounding relay is cut in and a regular "Morse" circuit formed, using the live feeder as one leg. The signals are slow but distinct, and work whether the mains are dead or alive.

The "detector" could be kept on the dead circuit until ready for starting, but as 260 volts is unpleasant, a battery and buzzer outfit is arranged, with the battery on the outside, so that the circuit is completely dead while being worked upon.

If but a portion of the system is to be made dead by using an intermediary switch, another outfit is arranged in parallel to that of the station. Both points then have all signals, the station paying no attention. This is done by using a higher resistance and more turns on the relay, using in this case 40,000 ohms and twice the turns. The connections are arranged as in Fig. 4.

The armature of the relay is normally up. When the insulation of the system is lowered by some one pressing his key, the armature falls. A number of operators could thus be in communication with each other from any point in the system to any other point.

At the station the maximum direct current is .025 ampere to suit the relay, while the alternating current, which leaks through, is but .0025 ampere, or so low that on the Weston direct current voltmeter it is just perceptible as a slight tremble of one-half division of the needle. A Weston alternating current voltmeter was used to measure the current of the choke coil when across 3,000 volts, and gave but five divisions.

Although the "detector" may seem to be a "jack of all trades" and so, good at none, still it is designed to work and does so faithfully under all conditions, putting into the hands of the switchboard and subway men an instrument which they can use and see for themselves the condition of the system. For this reason alone it would serve its purpose, as it promotes a feeling of security from trouble, giving, as it does, a warning hours before anything serious may happen; and even if a fault becomes a short circuit before it can be located, it still gives a pretty good estimate of its whereabouts.

Labor Unions and the Public Peace.

In a recent issue of *Iron Age* it was editorially said that the immunity enjoyed by those who commit or are responsible for the commission of serious crimes against persons and property to assist in the attainment of some end deemed desirable by organized labor, is tending to bring about conditions very closely resembling those of anarchy. That the partisans of the labor unions are manifesting an increasing contempt for everything in the form of law which does not leave them free to inflict such injury as they see fit upon those who interfere with their plans, is startlingly evident. Even when acts are committed which the wiser and more conservative labor leaders deprecate as ill advised and injurious, those who commit them may be sure of a moral and material support which is usually strong enough to stand between them and the consequences of their crimes against the public peace. Where this tendency is leading, and what may be expected when habitual immunity establishes the usage that a mob acting in the name, or in the interest, of organized labor may do what it pleases without responsibility under the law, is an interesting, if somewhat startling, subject of speculation.

A striking illustration of the tendency of which we speak was furnished at Waterbury, Conn., on the Fourth of July. A party of hilarious strikers took their position on the bank of a narrow stream opposite the plant of a manufacturing company which was making an effort to operate without their assistance, and for several hours bombarded it with highly incendiary missiles. Rockets were the favorite projectile, as they could be aimed very accurately from troughs set at the proper angle to give them the required trajectory of flight, were propelled with great force, and when intercepted exploded with violence, scattering fire in every direction. The purpose of the bombardment seems to have been to set fire to the plant, and incidentally to kill or cripple as many as possible of the employees. It may have begun in a reckless frolic, with very little idea of the probable consequences, but it soon developed into a bombardment conducted in grim earnest. The door of the carpenter shop was the target at which the rockets were first aimed. When this was effectually closed and protected, the windows were smashed one by one. The people inside the buildings were kept busy for several hours fighting fire. Vigorous efforts were needed to save the plant, and 2 or 3 employees were injured. One of the watchmen had his clothing set on fire and was painfully burned. No doubt it was "great fun" for the besieging party. Their siege was conducted without even a remonstrance from the police, and was discontinued only when it had ceased to be amusing. That no lives were lost or valuable property destroyed is due wholly to the vigilance of the besieged, and not at all to the consideration of the besiegers. Whatever their original purpose in beginning the bombardment, it soon developed into a deliberate purpose to inflict serious injury on the persons of the workmen and the property of the company. The case is typical, and for that reason we mention it.

In a well ordered community with a properly organized and efficient civil government such a thing might have happened, because unexpected, but it could not have continued very long without energetic police interference, and it would certainly have been followed by a searching inquest, and the indictment and arrest of those known to have participated in the outrage, some of whom would have had a good chance of going where work is done without union supervision.

We venture the prediction that in the instance under consideration the wheels of justice will be found to hang on their centers, and the chief value of the incident will be to give the strikers and their friends something to laugh over for a long time to come. It should be remembered, however, that between skyrockets and shotted field guns the line of demarcation is neither very wide nor quite visible. The question at issue is whether a mob of workmen may commit an act of war with any greater immunity than would be accorded an equal number of brigands or a band of tramps. To understand these matters we must divest the actors and their acts of any sentimental distortion. The honest workingman is an admirable member of the body politic, and is entitled to all proper respect and consideration; but if the honest workingmen becomes a rioter, an incendiary and a perpetrator of violence with intent to destroy life or inflict grave bodily injury upon those of whom he disapproves, he takes his place before the law with other malefactors, and is entitled to no more consideration than they. No right minded workingman, who is a good citizen and worthy of the privileges of citizenship, will, in his moments of sober reflection, dispute a proposition so obvious.

That there is a growing tendency on the part of organized labor to impose upon the members of labor unions obligations inconsistent with those of good citizenship is shown by the recent incorporation into the constitution of the "benevolent" branch of the Amalgamated Sheet Metal Workers' Association of the following amendment:

"Any person a member of the regular army or navy, or of the State militia or naval reserves, shall not be eligible to membership in this Association. Any member of this Association who shall become a member of either one of the above named bodies must tender his resignation of membership to the Association at once."

The obvious meaning of this clause is, no member of this union is permitted to put himself in a position where he may be called upon to protect life and property or to restrain the excesses of mobs. The State militia have on more than one occasion been called upon to supplement the police in sustaining the authority of the civil government, and in so doing have made themselves extremely inconvenient to the labor unions. To forbid the membership of a trade union to join the National Guard is to deprive them of the right to perform a duty which every young citizen should deem it a pleasure to render. When the object of such prohibition is to remove, as far as possible, one serious obstacle to free riot, the matter becomes one of grave significance.

It should be evident to the better class of workingmen, who are capable of thinking consecutively, that the tendencies of development now at work in the labor movement are full of danger, and that wiser leadership is needed to avert disaster to the interests of all classes of society. A little wholesome self assertion on the part of those who abhor socialistic heresies and do not feel that the red flag of anarchy is the only banner they are called upon to respect, would have a marked influence in restraining the excesses of those who are leading the unions where the self respecting mechanic and loyal citizen cannot follow without declaring himself an enemy to social order and good government. Never was the need of a great, wise, far-sighted leader so exigent as it now is in the field of organized labor.

A New Zinc Field.

Mr. Waldon Fawcett, writing in the *Scientific American*, says that the preliminary statistics covering a considerable portion of the year 1900 prove conclusively that there has been no exaggeration of the resources of the developed and undeveloped zinc and lead properties of the Missouri-Kansas district, constituting the great American zinc belt, and regarding which some seemingly remarkable predictions have been made during the past year or two. This district, which lies principally in southwestern Missouri, and will ultimately develop into one of the great mineral centers of the world, has been worked in a desultory sort of way for almost half a century, and it waited upon the advent of Eastern capital within the past couple of years to bring the ore production to its present yield, which approximates $1,000,000 per month.

It was not until 1874 that a geologist touring the district discovered the true nature of the mineral being scattered on the dumps. Then there was a rush to secure the stocks on hand at the various properties, and when the statistics for the decade were made up in 1880 it was found that there had been sold nearly 60,000 tons of zinc, as against 100,000 tons of lead. In 1897 the district produced $5,000,000 worth of ores, or nearly as much as during the whole ten years from 1870 to 1880, and in 1898 the balance sheet showed an aggregate production estimated at $7,000,000.

Meanwhile a change was wrought, and lead instead of zinc became the by-product. An increasing degree of attention was paid to the more recently discovered mineral, until at the present time 10 dollars' worth of zinc is produced for every dollar's worth of lead taken from the ground. This new field has enabled the United States to become an important factor in the zinc market of the world. A few years since America contributed scarcely one-eighth of the world's supply. At the present rate of increase this country will ere long furnish more than one-fourth of the aggregate consumption. This little tract, which is now yielding as high as $300,000 worth of zinc ore per week, is at present supplying fully seven-eighths of all the zinc used in the United States, and it must therefore be apparent that the export trade has not as yet undergone any considerable development, but this is only a question of time, and in anticipation of it a number of the smelters of Belgium and Wales have already established agencies in Joplin, the commercial center of the mineral belt.

The three zinc ores found in the district are the sulphide, silicate and carbonate. The sulphide, which is at once the most abundant and most valuable ore, occurs in several varieties, distinguished chiefly by color. The purity of this ore is well illustrated by the fact that it seldom runs below 60 per cent. metal, and in some cases it is practically chemically pure, running ⅔ metal and ⅓ sulphur. The future developments in the working of the zinc properties are difficult of prediction, not only because geologists contend that still larger bodies of ore will be found at greater depths than have yet been reached, but also by reason of the irregular distribution of the zinc ore; it being found in thin sheets in crevasses of limestone; in huge chambers; buried in clay; disseminated through solid brecciated rock, which requires blasting, and forming a lining for cavities. Zinc and lead are very frequently mined together, the 2 ores being found in close proximity.

Not only do the peculiarities already noted exist, but the distribution of the zinc ore is by no means regular, and the test drills have pierced half a dozen strata. All the mining yet done has been at shallow depths. The Eleventh Hour, the deepest mine operated in the district, is only 240 feet deep, and the average shaft has a depth of not more than half that distance. Deep drilling has shown, however, that beyond the 400-foot level there are larger bodies of mineral deposits than in any of the shallow diggings now being worked. It is now estimated that it will require 20 years to exhaust the surface workings and get down to the workings of only 200 feet and over, so that it will doubtless be some time before the miners are ready to get at the 500-foot level, which experts declare will contain more ore than all the shallow mines combined.

The formation of the district is such that very little timber support is required in any of the mines. The mines are free from fire damp, and the miners are subjected to none of the inconveniences which must be borne by coal miners, who necessarily operate in very cramped quarters. Frequently these zinc miners work in great caverns 200 feet in length, perhaps a third as wide, and fully 40 feet in height—a chamber of sufficient size to insure the presence of good air.

The cleaning of the ore is a somewhat complicated operation. Immediately upon its arrival at the surface it is transferred to huge bins in the mills, from which it is fed into the crushers, a good sized stream of water being turned into the crusher simultaneously with the raw material. The ore after it has been crushed to the fineness of sand, is carried by the water into sluice boxes, which are provided with false bottoms that collect the ore and allow the dross to escape in much the same manner that gold is washed out of gravel by placer miners. It is during the cleaning process that the lead and zinc are separated, the former having nearly double the specific gravity of the latter. The average mill has a capacity of 100 tons per day, but each 100 tons of material fed into the crushers yields only about one-tenth that amount of pure cleaned ore. This may seem a surprisingly small proportion, and the mine operators themselves agree that there is a tremendous waste, but say that the loss will shortly be greatly reduced by the introduction of improved methods.

There has been in the history of the development of America's natural resources few instances to parallel the manner in which the prices of zinc have gone up within the past few years. The average for the year 1897 was slightly over $18 per ton; for 1898, $21 per ton, and for the year which closed in June, 1899, over $34 per ton. More surprising still is the fact that in the first six months of 1899 the average price of all the zinc sold in the Joplin district was $44 per ton, and in some instances sales were made at $55 per ton. Some idea of the profits made possible to the producers may be gained from the fact that the average cost of production does not exceed $14 per ton, and in many localities the ore can be cleaned and made ready for market at a total expenditure of $10 per ton.

There are almost 800 mines in the Joplin district, and they give employment to over 10,000 men. All classes of citizens have engaged in the mining operations, some with almost no capital. In other cases a group of miners will go into partnership with some local merchant, who furnishes the money with which to purchase powder and the necessary tools. Joplin, which a few years ago was a little more than a village, now has a population of 30,000 and there are in the district several other mining camps, all of which are connected by the longest electric railway in the world.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

THE proprietors of the Scranton (Pa.) Gas and Water Company have purchased the plants and rights of the Archbald Water Company, which supplies water to the nearby boroughs of Archbald and Blakely.

THE Spring Valley (N. Y.) Gas Company has been incorporated. It is likely a creation for which Mr. B. Van Steenbergh and his friends are responsible.

THE South Jersey Gas, Electric and Traction Company has been awarded a contract for the public street lighting of Camden, N. J., in so far as that service is or may be performed by gas, on the following basis—the contract is to run for five years: Ordinary burners $21 per lamp per annum; single Welsbachs, $28 each; double Welsbachs, $44 each.

MR. F. DE V. THOMPSON is now officially known as Manager of the Springfield (Mass.) Gas Light Company, vice Mr. Samuel J. Fowler, resigned.

THE completed list of officers in the Peoples Gas Light Company, of Rutland, Vt., which property changed hands some time ago, is as follows: Directors, L. W. Baldwin, H. W. Burgett, W. H. Baldwin, A. H. Keyes, H. R. Kingsley and C. H. West. President, L. W. Baldwin; Vice-President, H. W. Burgett; Secretary and Treasurer, Charles H. West.

THE Georgetown (Ky.) Water, Gas and Power Company has been incorporated by Messrs. Ross Holman and J. P. Jackson. The concern is capitalized in $200,000. We take it this means a consolidation of the heretofore existing gas, water and electric plants.

CONSIDERABLE damage was recently occasioned to the plant of the Grand Island (Neb.) Gas Company through a fire that started in its coal storage sheds. The property was insured. It is thought that the fire was of incendiary origin.

THE foreclosure sale of the plant and franchises of the Citizens Gas Company, of Bridgeport, Conn., which was ordered for the 10th inst., was on that date postponed to the 14th prox., which is the day following the date set for the expiration of the offer of certain capitalists for the purchase of the shares of the old Bridgeport Gas Light Company at 300 on the par of 100. Selling Agent Miller, when asked why the postponement was declared said he ordered it because he thought the property would sell better later on. This postponement is the second one.

THE residents of Ocean Grove, N. J., who have long been governed by certain trafficking money making religionists, are concerned about a gas supply, which supply has not been forthcoming merely because the religionist owners are afraid that a gas service would interfere with the religiously owned electric lighting plant. That gas is wanted there would seem to be best proved by a petition of certain property holders, who ask that either the Ocean Grove Association be directed to construct a gas plant or that the Consolidated Gas Company of New Jersey be given the right to lay mains through the Grove. The impelling cause of the petition is the desire to use gas for cooking purposes, which desire is intensified from the frequent fires caused during the last three summers in the Grove through the use of wickless oil stoves. It looks as if "the Deacons" would have to yield to public sentiment; and if they could look beyond their nasal appendages they might easily see a supply of gas in their coal-saving territory would not interfere a bit with the profits out of their wretchedly managed electric lighting plant.

THE proprietors of the Atlas Pipe Wrench Company, of New York and San Francisco—we might add that the Company's works are in New Haven, Conn.—have arranged for the placing on the market of a tube cleaner for tubular boilers. We do not know much about the device at the time of writing, but hope to increase our knowledge respecting it later on.

WORK on the plant of the Dover, Port Oram, and Rockaway Gas Company, of Dover, N. J., has been commenced. The construction is under the immediate direction of Capt. W. H. White, whose personal representative is Mr. Frederick Egner. The Dover Company's Superintendent is Mr. J. W. Baker.

IT is reported that negotiations are to all intent completed for the merging of the gas and electric lighting interests of Fremont, O. Perhaps the thought or report is based on the fact that the Fremont Electric Light and Power Company has secured a contract for the public lighting of Fremont, in so far as that is done by means of electric arc lamps, for 10 years, on the basis of an annual payment of $70 per lamp. Under the circumstances, one might be forgiven for hoping that the Gas Company waits awhile before going into the agreement, unless the Electric Light and Power Company is ready to buy for cash at the present time.

THE General Council of Louisville, Ky., in recent joint session, renamed Messrs. Joseph Scheffler, M. R. Wheat, H. R. Philips and W. J. Adams to serve the city on the Board of Directors of the Louisville Gas Company.

AT the annual meeting of the Ashland (Pa.) Gas Company the Directors chosen were: H. F. Bright, Jno. X. Dence, Chas. C. Graeber, F. E. Heinze, Wm. A. Marr, Geo. Morgan and Adam Waldner.

THE Attica (N. Y.) Water, Gas and Electric Company has applied for the right to supply gas and water to Batavia, N. Y. Heretofore the furnishing of gas to Batavia has not proved a profitable operation.

THE parties in interest in the Morris (Ills.) Gas Company, which does not seem to be doing much that is profitable under the direction of its receiver, have applied to the Council for a revision of the Company's charter. The applicants urge as their main chance that gas cannot be sold profitably at the present prescribed rates, which rule at $1.50 per 1,000 on illuminating account and $1.35 on fuel account. They ask that the schedule be increased to $1.75 and $1.50 per 1,000 respectively.

THE Poughkeepsie (N. Y.) Electric Light and Power Company is seemingly anxious to secure control in the Poughkeepsie Gas Company. This anxiety is praiseworthy, for its proprietors would look to have played a losing game in the main city of Dutchess county for many months. Why do not Messrs. Young and Atwater, of the Gas Company, buy out the Brinckerhoff concern? Mr. Young certainly knows the profit that is in the supply of light from central stations—especially those of the gaseous sort.

MR. BENJAMIN J. ALLEN, brother of Mr. Walter A. Allen (the clever Superintendent of the New York Mutual Gas Light Company) has been appointed General Superintendent of the Everett (Mass.) works of the New England Gas and Coke Company. It looks as if the coke people were at last anxious to know something about the gas division of their "enterprise."

MR. J. B. DAVISON, formerly Superintendent of the electric division of the properties of the Brookline (Mass.) Gas Light Company, has been appointed General Manager of the electric properties of the Newburgh (N. Y.) Illuminating Company.

WHAT is the matter with the capitalists in charge of ihe project for the construction of the gas works at Steelton, Pa.? There is no good reason for the abandonment of the scheme, since the place is amply able to support a venture ot the sort that would not be over-capitalized.

A HEBREW merchant of Minneapolis, Minn., recently complained to Gas Inspector Roberts that the quality of the gas supplied to his clothing store was not up to standard. The Inspector having made a test, additional to the regular and stipulated ones, informed the merchant that the trial showed the gas to be well beyond the stipulated standard.

ANOTHER step in the consolidation of the gas lighting interests of Staten Island, N. Y., is shown in the filing of papers incorporating the properties of the Richmond County Gas Light Company with those of the New York and Richmond Gas Company. The capitalization of the amalgamated concern is put at $1,500,000.

THE U. S. Patent office has granted protection for a smoke consuming device to Mr. August Kippel, of Vienna, Austria, which seems to have merit. The Patent number is 678,261, and its claims may be found in the Patent Office *Gazette*, dated the 9th inst.

MAYOR FRENCH, of Gloucester, Mass., says that gas should be sold in that city for $1 per 1,000. Mr. French should go further and declare that codfish and mackerel should be disposed of at $1 per ton in Massachusetts famous fishing disposal centers—of which Gloucester is not the least.

THE American Light and Traction Company, formed for the purpose of amalgamating the gas companies of Grand Rapids, Mich., Milwaukee and Madison, Wis., and St. Joseph, Mo., has been organized. Its Directors are: E. McMillin, W. E. Case, W. W. Foster, Geo. P. Sheldon, A. B. Leach, H. B. Hollins, L. H. Withey, Jas. Campbell, H. H. Hamill, J. J. Emery, P. Lehman, T. H. Hubbard, A. G. Hodenpyl, A. P. Fitch, G. T. Maxwell, John S. Foster, G. A. Madill, W. L. Bull and Jas. C. Parrish. The Executive Committee comprises Messrs. McMillin, Hollins, Bull, Leach, Hubbard, Case, Foster, Hodenpyl and Sheldon. No matter what comes or goes with the Company it undoubtedly has ample numbers "from whence" to select its managing officers.

THE Pawtucket (R. I.) Gas Company proposes to extend its mains to the adjoining district of Saylesville.

THE signs of the times point to the consolidation of the gas and electric lighting interests of Baltimore, Md. Such merging would appear to be the only way of enabling the electric lighting people to save themselves.

AN ordinance now before the City Council of Dayton, O., seeks to compel the Dayton Gas Light and Coke Company to put its gross selling rate at $1 per 1,000 cubic feet, a rebate of 15 cents per 1,000 to rule where the user pays his bill within 5 days from the date at which it was rendered. For a supply on public account the ordinance declares that the Company may not charge a price "to exceed that prevailing in Cincinnati."

THE *Gas World* notes that four scampish residents of Paris, France, devised an ingenious plan, which brought them to grief after a season of prosperity lasting quite on to 9 days. Observing that a good deal of interest was being taken over the question of a reduction in the price of gas to consumers, they founded an association with the compound title of the "League for the Defence of the General Interests of Gas Consumers." Of the four, one was President, another was Secretary, the third was Treasurer, and the fourth, who was the originator of the scheme, was known as Chief Administrator and Superintendent. They employed about 20 more or less innocent agents, armed with official looking credentials and documents, whose duty it was to go about collecting signatures to petitions to the Town Council, and also, which was more important, collecting contributions to the good cause. Of these contributions the agents retained 40 per cent. in name of commissions. Accounts were made up every evening in a café, and on the whole the quartet made about $40 each. They made the mistake of never going near the Town Council with their petitions, and it was such failure that finally landed them in confinement for some months to come.

THE Bay City (Mich.) authorities are still struggling with the terms of the franchise under which they propose to invite capitalists to bid for the right to construct and operate a gas works at that point.

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MONDAY, JULY 22, 1901.

Introducing American Methods in England.

The *Scientific American* says that the immense workshop that the British branch of the Westinghouse Engineering and Manufacturing Company are having erected at Manchester is rapidly approaching completion. When in working order it will be a busy hive of British industry, giving employment to some 6,000 people. Americans will control the business for the first few months, and will then be succeeded by English engineers who at present are being initiated into American business methods at Pittsburg. The works cover 40 acres of ground and are divided into 7 departments. The machine shop covers 8 acres. From the north end of this shop to the south end of the power house there is a single stretch of roof 1,135 feet in length by 427 feet in width. The steel and iron foundries each cover nearly 6 acres; while the brass and malleable iron foundries each cover approximately 4 acres. There is also a fine 6-story block of offices with a frontage of 250 feet. The building contains 15,000 tons of steelwork, which has cost $90 a ton, and 9,000,000 feet of timber. The electricity will at first be generated by steam power, but this will be subsequently supplanted by gas engines. All through the grounds culverts are laid for the cables for the transmission of power throughout the various departments. The buildings alone are costing $4,500,000, and the plant to be installed will represent another $2,000,000. The location of the factory is ideal. It stands on the bank of the Manchester Ship Canal, so that vessels can proceed up to the very doors of the factory, which will result in great economy in handling the goods, while the Bridgewater Canal, which also runs alongside, will enable coal to be purchased and delivered at the factory very cheaply; and it is also in close connection with the principal railroads of the country. When completed it will be one of the largest engineering factories in Great Britain.

The Market for Gas Securities.

In common with the sharp recovery in the general list, gas shares moved up with a vim during the week. Consolidated sold well above 218, and quite a bit of trading was done in it. Yesterday (Thursday) 1,300 shares were sold. These changes are merely the result of stock trading pure and simple, for news of moment in connection with what may be termed the politics of the Company is not to be had. Other city shares as to quotations are featureless, unless inactivity may be considered such.

Brooklyn Union is somewhat weaker, though, as was said above about Consolidated, there is no good reason for any change in its value. It is a pretty safe security "to have and to hold."

Peoples, of Chicago, has recovered some from the low figures made in it early in the week.

Laclede common goes on steadily towards par. It is bid 93, and offered at 95.

Baltimore Consolidated sold off some on the putting out of a fairly large block of investment stock. The block was taken by a strong interest that is working towards the complete rehabilitation of the Company. Washington (D. C.) is at 300.

Nothing of positiveness has been determined respecting the likely purchasers of the Gas and Electric Company, of Bergen county, N. J. There can be doubt of the worth of the Company's district as a money maker, and the purchasers will have very little expenditure to make on plant account for years to come.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 22.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	217	218
Central Union, Bonds, 5's.	3,000,000	1,000	107	108
Equitable Bonds, 6's	1,000,000	1,000	105	
" 1st Con. 5's	2,300,000	1,000	115	118
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	306	311
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	108¾	109¼
Northern Union, Bonds, 5's.	1,250,000	1,000	106	108
New York and East River				
Bonds 1st 5's	3,500,000	1,000	111	115
" 1st Con. 5's	1,500,000		108	111
Richmond Co., S. I.	348,650	50	100	..
" Bonds	100,000	1,000	103	..
Standard	5,000,000	100	135	..
Preferred	5,000,000	100	158	
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115	117
Yonkers	299,620	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	208	214
" " Bonds (5's)	15 000,000	1,000	118	119
Bay State	50,000,000	50	5/8	3/4
" Income Bonds	2,000,000	1,000	.	75
Binghamton Gas Works	450,000	100	20	35
" 1st Mtg. 5's	509,000	1,000	92½	95
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	6½	8
" " Bonds, 5's	5,250,000	1,000	73	76
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000		
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	103	103¼
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,780	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	103
Consumers, Toronto	1,700,000	50	215	216
Consolidated, Baltimore	11,000,000	100	63	63½
Mortgage, 6's	3,600,000	..	..	115
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000		..	112
Consolidated Gas Co. of N.J.	1,000,000	100	13	15
" Con. Mtg. 5's	380,000	1,000	81½	83
Consolidated G. & E. Co.'s., Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,825,500	50		89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	89	89½
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	.	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	..	
" Bonds	2,000,000	..	54	58
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	102	104
Hartford	750,000	25	240	250
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	68	70
" Bonds, 6's	2 650,000	..	98	
Jackson Gas Co.	250,000	50	70	75
" 1st Mtg. 5's	200,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	103
Laclede, St. Louis	10,000,000	100	93	95
Preferred	2,500,000	100	98	99
Bonds	10,000,000	1,000	..	108½
Lafayette Gas Co., Ind.	1,000,000	100		60
Bonds	1,000,000	1,000	48	55
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	102½	108
" 6 per cent. scrip, due 1910	100,000	25	87	89
Montreal, Canada	2,000,000	100	184	184¾
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	103
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	114½	114½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	..	.
St. Paul Gas Light Co.	1,500,000	100	50	54
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	800,000	1,000	..	..
General Mortgage, 5's	2,465,000	1,000	88	90½
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	85	87
Syracuse, N. Y.	1,750,000	100	16	19
Bonds	1,612 000	1,000	91	93
Washington, D. C	2,600,000	20	298	300
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	..	93½	95
Wilmington, Del.	600,000	50	200	201

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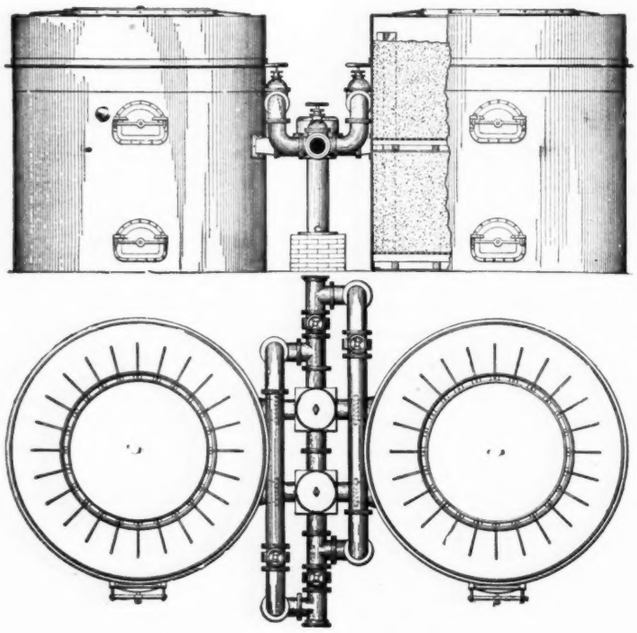

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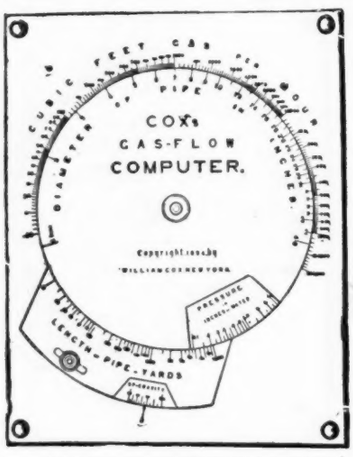

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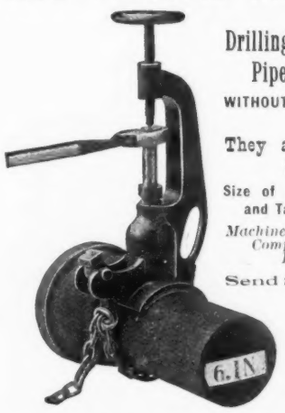

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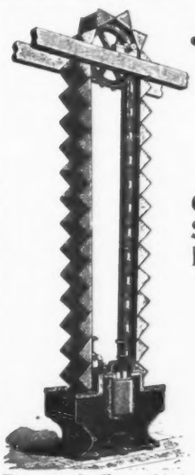

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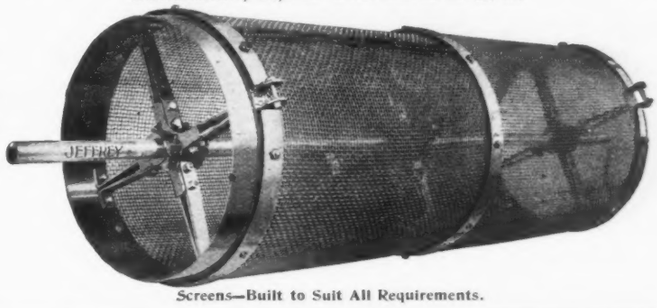

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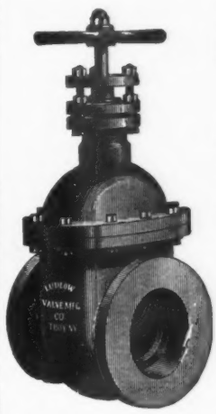

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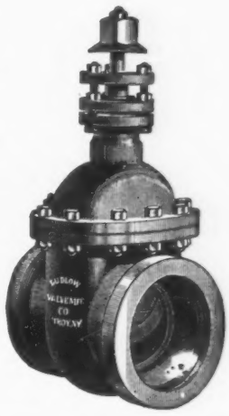

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(See circular letter, American Gas Light Journal, June 24th.)

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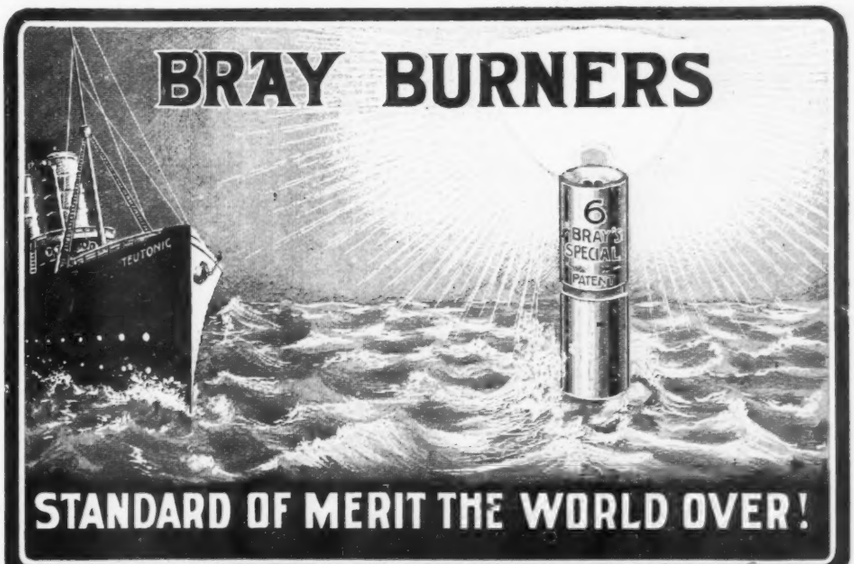

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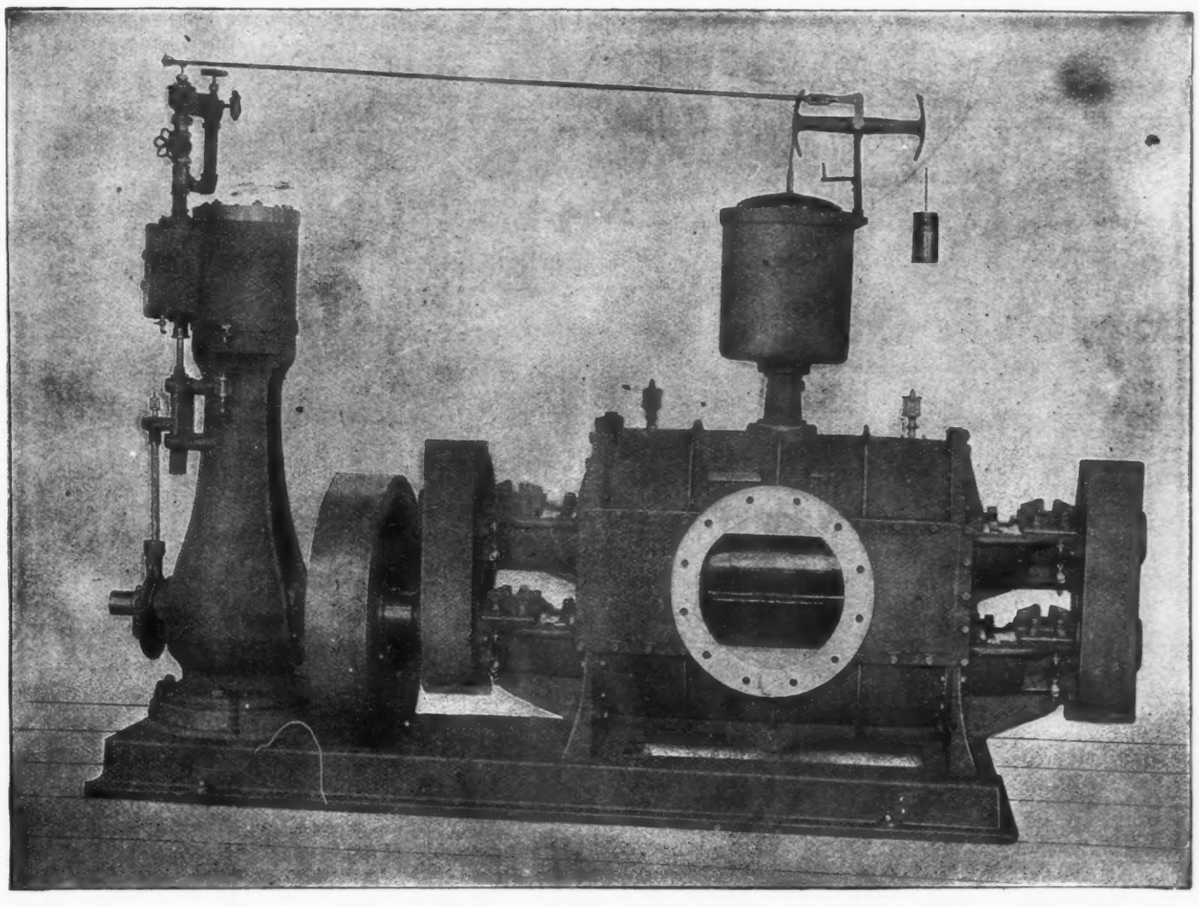

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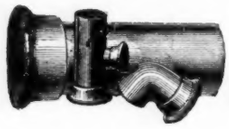

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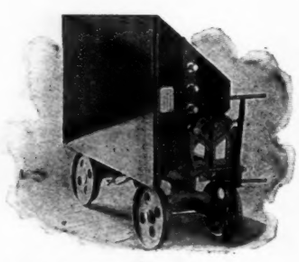

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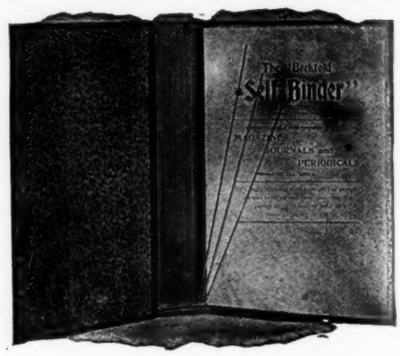

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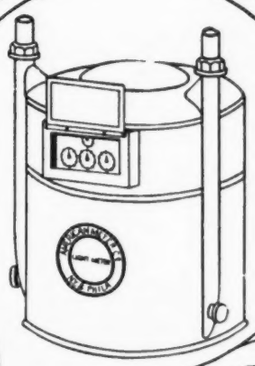

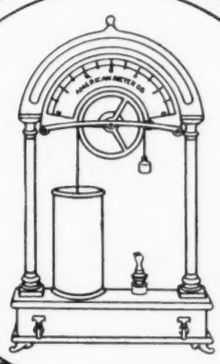

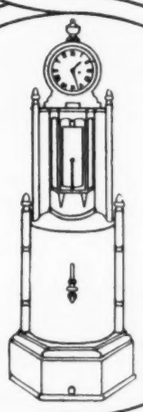

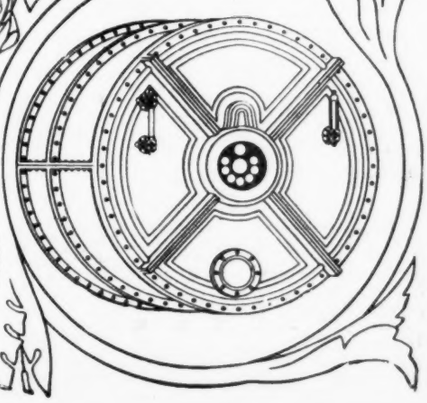

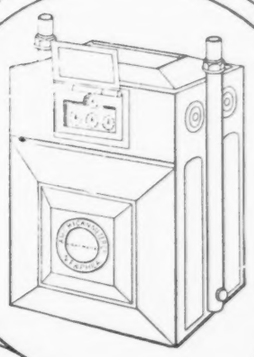

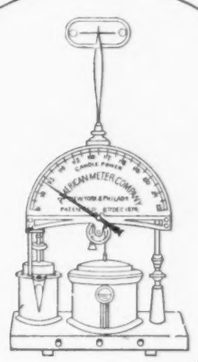

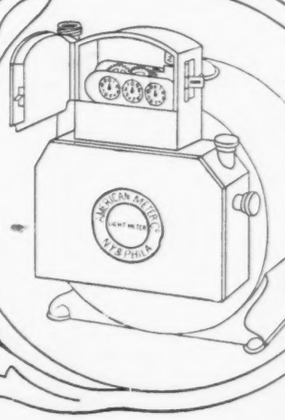

PUBLIC LIGHTING TABLE.

AUGUST, 1901.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Thu.	1	7.40 PM	8.40 PM	7.10	3.30
Fri.	2	7.40	9.20	7.10	3.30
Sat.	3	7.40	9.50	7.10	3.30
Sun.	4	7.40	10.20	7.10	3.30
Mon.	5	7.40	11.00	7.10	3.30
Tue.	6	7.40 LQ	11.40	7.10	3.45
Wed.	7	7.40	12.30 AM	7.10	3.45
Thu.	8	7.40	1.20	7.10	3.45
Fri.	9	7.40	2.10	7.10	3.45
Sat.	10	7.40	4.10	7.10	3.45
Sun.	11	7.30	4.10	7.10	3.45
Mon.	12	7.30	4.10	7.10	3.45
Tue.	13	7.30 NM	4.10	6.55	4.00
Wed.	14	7.30	4.10	6.55	4.00
Thu.	15	7.30	4.10	6.55	4.00
Fri.	16	7.30	4.10	6.55	4.00
Sat.	17	7.30	4.10	6.55	4.00
Sun.	18	7.50	4.20	6.55	4.00
Mon.	19	8.20	4.20	6.55	4.00
Tue.	20	8.50	4.20	6.45	4.10
Wed.	21	9.30 FQ	4.20	6.45	4.10
Thu.	22	10.10	4.20	6.45	4.10
Fri.	23	11.00	4.20	6.45	4.10
Sat.	24	11.50	4.20	6.45	4.10
Sun.	25	12.50 AM	4.20	6.45	4.10
Mon.	26	2.00	4.20	6.45	4.10
Tue.	27	3.00	4.20	6.30	4.20
Wed.	28	No L.	No L.	6.30	4.20
Thu.	29	No L. FM	No L.	6.30	4.20
Fri.	30	No L.	No L.	6.30	4.20
Sat.	31	7.00 PM	8.20 PM	6.30	4.20

TOTAL HOURS LIGHTING DURING 1901.

By Table No. 1.	Hrs. Min.	By Table No. 2.	Hrs. Min.
January	220.10	January	423.20
February	192.30	February	355.25
March	180.00	March	355.35
April	158.30	April	298.50
May	140.40	May	264.50
June	135.40	June	234.25
July	138.00	July	243.45
August	156.20	August	280.25
September	174.40	September	321.15
October	202.30	October	374.30
November	220.40	November	401.40
December	241.30	December	433.45
Total, yr.	2161.10	Total, yr.	3987.45

NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

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.... OF AMERICA ....

No. 36.

Controls and Operates the

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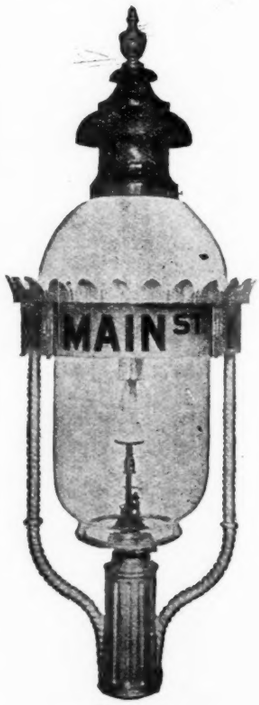
Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



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THE INCOMPARABLE

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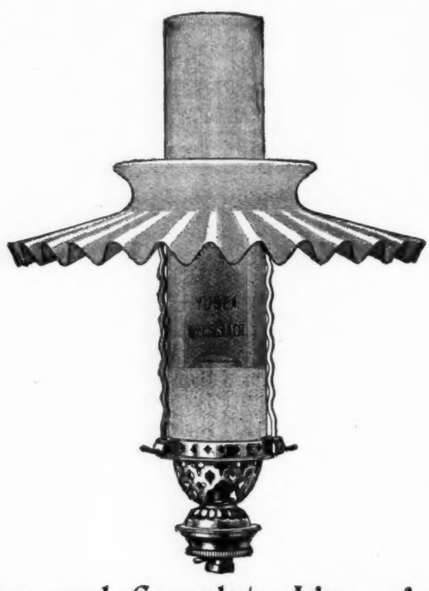
FINEST EXAMPLE

OF INCANDESCENT

GAS LIGHT

EVER EXHIBITED.



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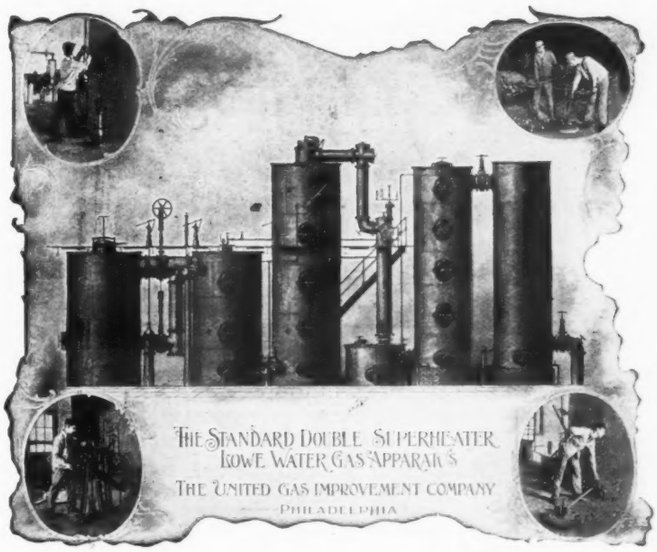
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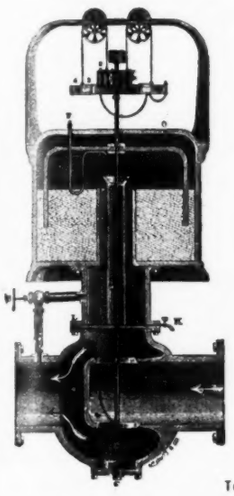

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"Iron Sponge" and Natural Oxide

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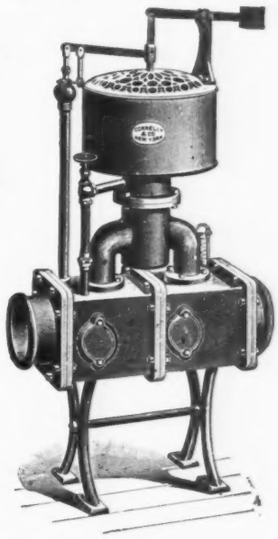

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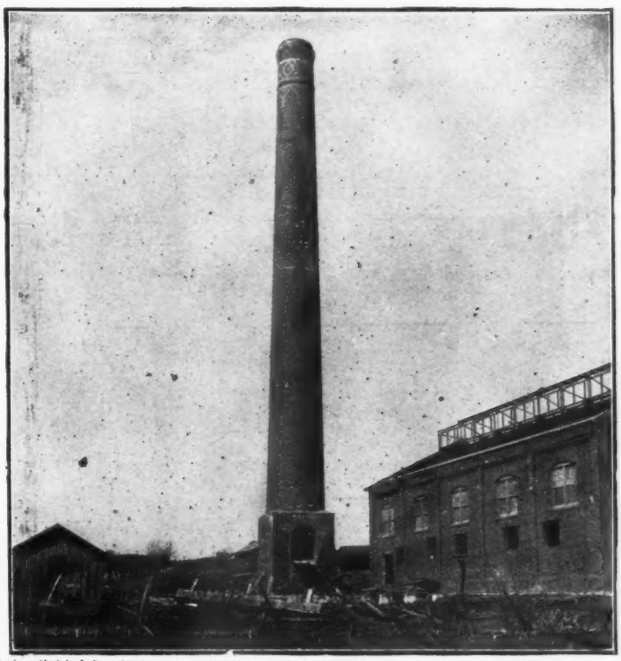

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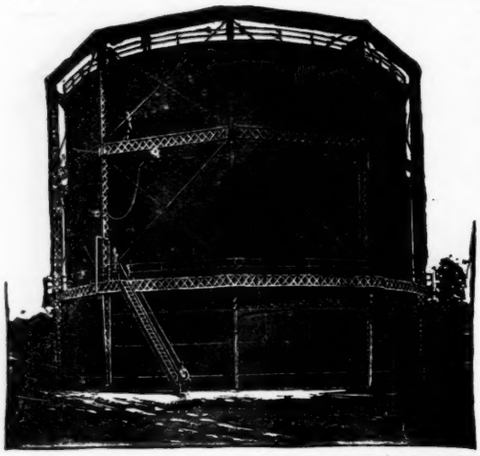

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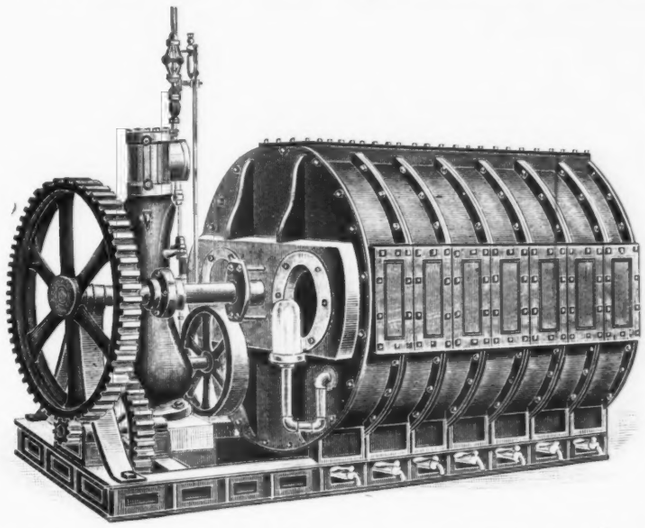

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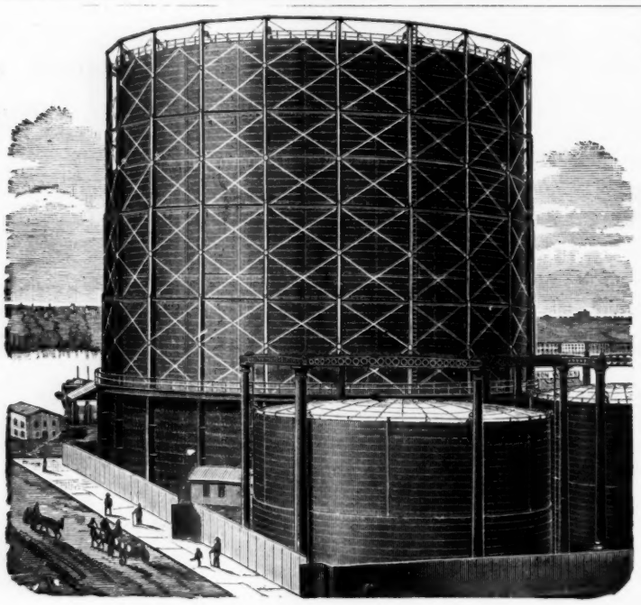

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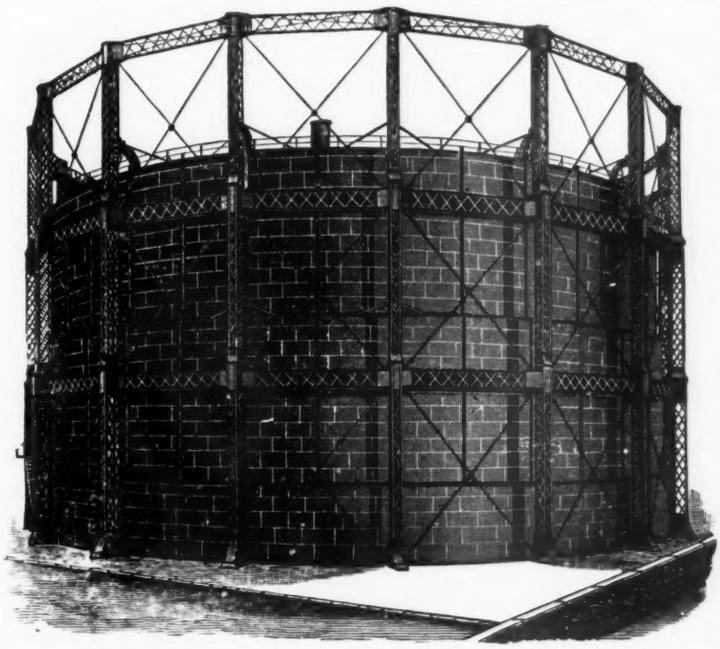

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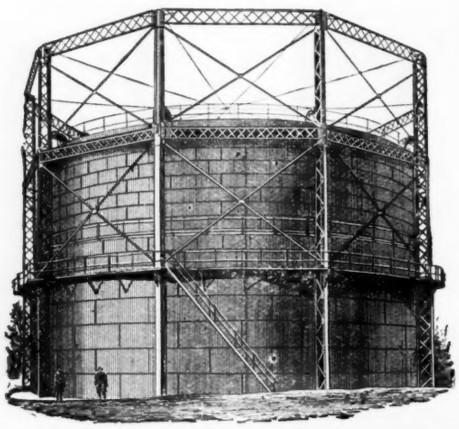

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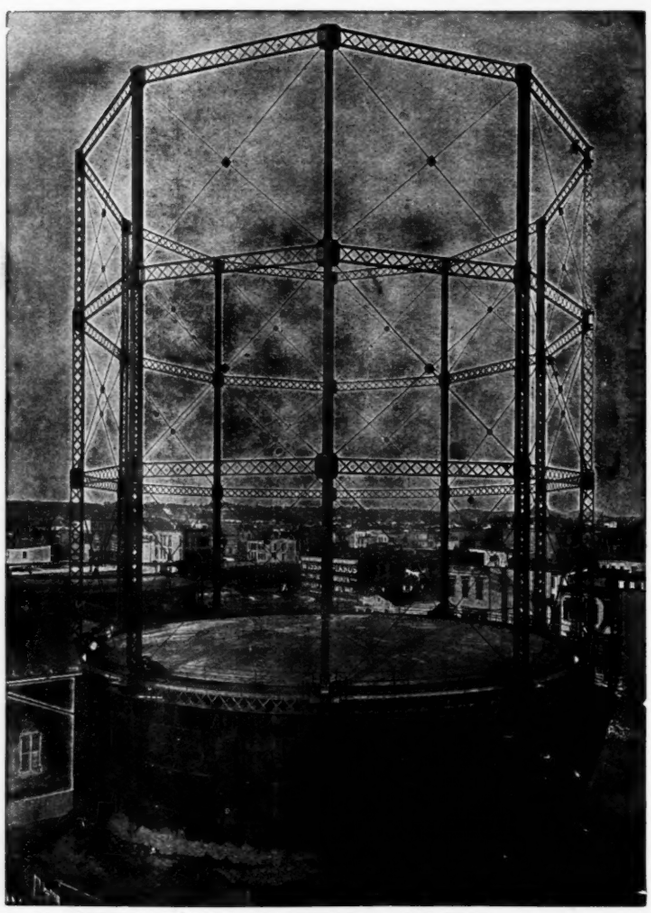

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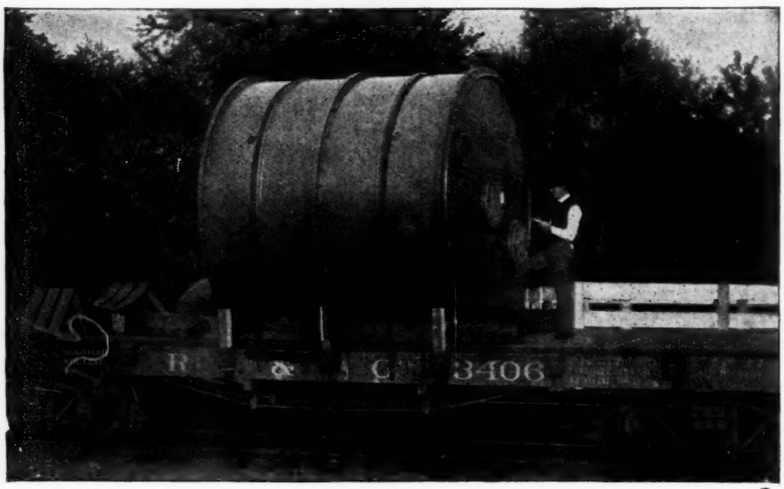

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